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FEBRUARY 1960

WATER & SEWAGE WORKS

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UNIVERSITY MICROFILMS
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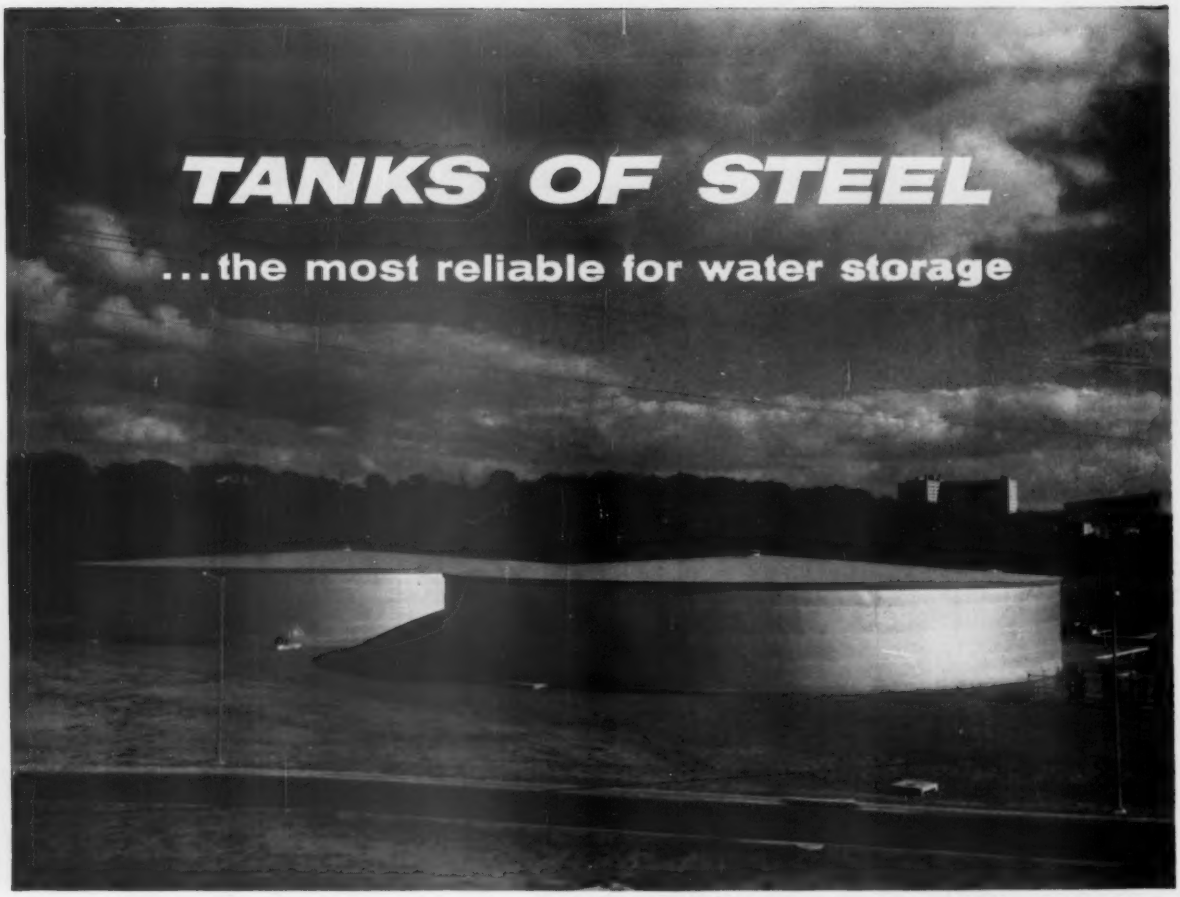
ANN ARBOR, MICH.
COMP

Pipe Jointing
page 46



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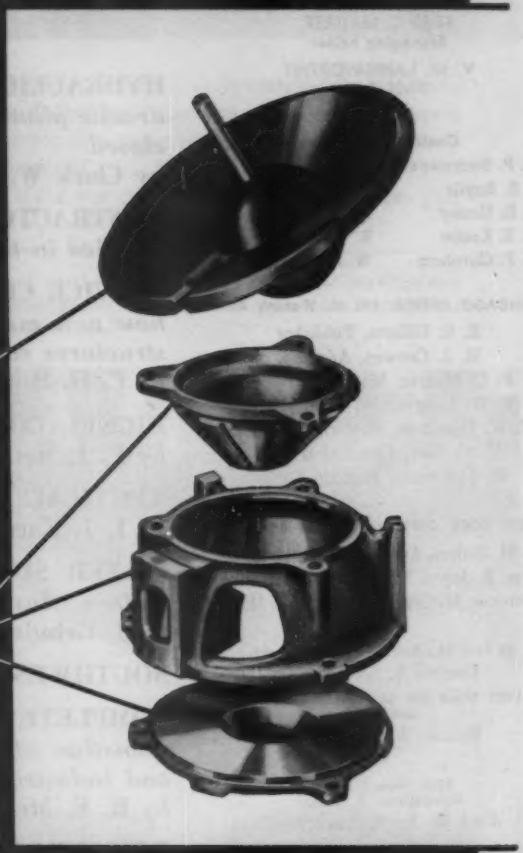

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Vol. 107 No. 2
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WATER & SEWAGE WORKS

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Briefs

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Complete Mixing of Activated Sludge is one of the newest modifications for sewage and industrial waste treatment. The relation of loading to effluent BOD to mixed liquor suspended solids is developed by a leader in research and development on biological treatment—Page 69

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Electric Switchgear in Sewage Treatment Plants describes the four basic types of load distribution centers, their relative costs, dependability and flexibility. Of value to all who operate or design sewage treatment plants in this modern day of increased use of electrically driven equipment, see Page 86

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Corrosion Testing for Water Works .....by W. E. Kirkendall
Economics of Variable Speed Pumping .....by W. R. Leopold
Continuous Recording of B.O.D. .....by J. W. Clark
Sanitary Sewer Problems .....by E. G. Studley
Liquid Chemical Feeding .....by V. W. Langworthy

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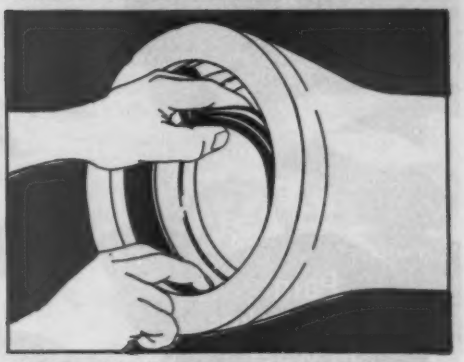
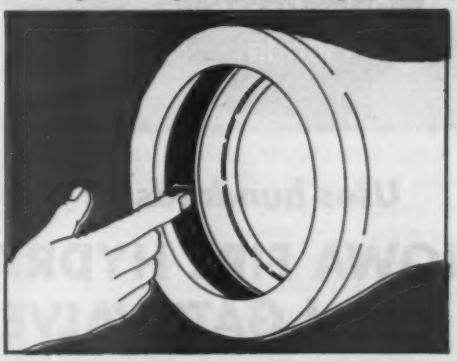
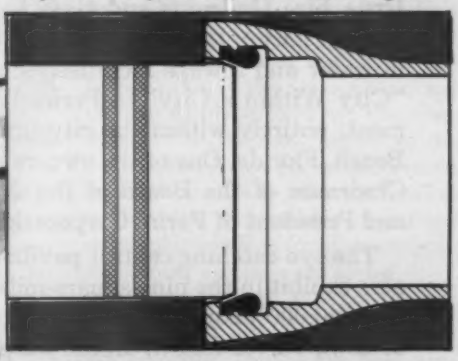


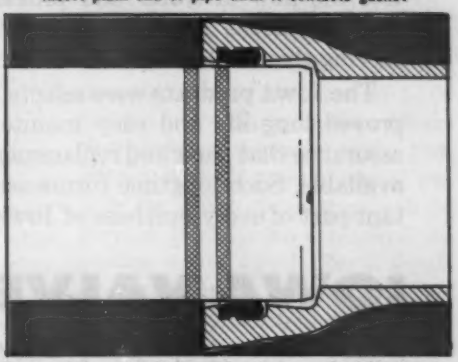
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

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IOWA FIRE HYDRANTS and GATE VALVES

IOWA Fire Hydrants and Gate Valves form an important part of the more than $4,000,000 investment in water and sewage facilities for a completely new "City Within a City", a Perini-Westward development, entirely within the city limits of West Palm Beach, Florida. One of the owners is Louis R. Perini, Chairman of the Board of the Milwaukee Braves and President of Perini Corporation.

The eye-catching central pavilion dominates a 12-acre exhibit in the nine-square-mile area where more than 40,000 people are expected to live. Hundreds of Iowa valves and hydrants were installed to control the flow of water and provide fire protection throughout the 100 miles of cast iron water mains serving this $450,000,000 development.

The IOWA products were selected because of their proved long life and easy maintenance... plus the assurance that parts and replacements will be always available. Such longtime future service is an important part of every purchase of IOWA products.

One of hundreds of IOWA fire hydrants and gate valves being installed at Perini-Westward development within the city limits of West Palm Beach, Fla.

Let us send you details on IOWA'S *complete line of valves and hydrants*

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News—Here & There

Publication of Waste Facilities Inventory Announced

PHS announces publication of physical and operating data as of January 1, 1958 on all municipal and some industrial waste treatment facilities in the U.S.

Published in 9 volumes "Inventory of Municipal and Industrial Waste Facilities" PHS publication No. 622 is available from the Supt. of Documents, Government Printing Office, Washington, D. C. for $10.25.

Individual volumes are available at the following prices:

Volume I	.65	(States of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont)
Volume II	1.75	(States of Delaware, New Jersey, New York, Pennsylvania)
Volume III	1.00	(States of Kentucky, Maryland, North Carolina, Virginia, West Virginia and the District of Columbia)
Volume IV	1.00	(States of Alabama, Florida, Georgia, Mississippi, South Carolina, Tennessee)
Volume V	1.75	(States of Illinois, Indiana, Michigan, Ohio, Wisconsin)
Volume VI	1.25	(States of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota)
Volume VII	1.00	(States of Arkansas, Louisiana, New Mexico, Oklahoma, Texas)
Volume VIII	.60	(States of Colorado, Idaho, Montana, Utah, Wyoming)
Volume IX	1.25	(States of Arizona, California, Nevada, Oregon, Washington, Alaska, Hawaii)

Morrell Vrooman Sr. Expires

Morrell Vrooman, Sr., a senior partner of Morrell Vrooman Engineers, a consulting engineering firm, died recently at the age of 84.

He was an honorary life member of the American Society of Civil Engineers and of the American Water Works Association. Mr. Vrooman was also a charter member of the New York State Sewage and Industrial Wastes Association.

Skin Diver Checks Gaslifter Performance

SCUBA, (Self-contained underwater breathing apparatus), was used recently to check circulation currents of a Walker Process Gaslifter digester circulator-mixer. The 70 ft diameter equipment had been installed at the new Westside sewage treatment plant in Corpus Christi, Texas.

J. D. Walker, President of Walker Process and skin diving enthusiast, entered and explored the new digester which has been filled with water for test purposes. He was able to trace and measure current velocities and circulation patterns by means of puffs of dye created by squirting white casein paint from a plastic ketchup dispenser.

This use of underwater equipment allowed exceptionally accurate measurements from which Gaslifter performance under full scale conditions could be plotted. The information obtained is considered more dependable and more comprehensive than what has been previously obtained by other and older methods.

Walker is probably the first man who ever swam around in a sewage plant digester—and enjoyed it.

New Sewage and Industrial Wastes Index

The Federation of Sewage and Industrial Wastes Associations in Washington, D. C., has announced that a new, ten-year Index is available for their Sewage and Industrial Wastes publication. This Index, for the decade ending December 1958, is a result of the continuation of the Federation's indexing practice initiated in 1948 with the publication of the twenty-year Index to the Sewage Works Journal, the predecessor to the present Journal.

Included in the latest Index is the material published in the Sewage Works Journal during 1949, the last year the Federation Journal used this name. Effective January 1950, the Journal became Sewage and Industrial Wastes, and its frequency of publication changed from bi-monthly to monthly. The twenty-year Index included 115 issues of the Journal; the ten-year Index includes 114 issues.

Like its predecessor publication, this Index provides the key to the specialized information on waste water collection and treatment which was published in the Journal. The 10,000 entries are a result of a detailed search of the ten volumes, and the key words selected are those believed to be the most helpful to the reader. The Index covers all original contributions and pertinent notices published. It also includes subject and geographical indices for abstracts published over the ten year period.

With the availability of the ten-year Index, a new aid to the subject matter of the Journal has been provided for all those interested in the field of waste water technology. The prices for the volume are $4.00 for a maroon buckram binding, and $3.00 for the heavy paper binding. All orders should be submitted to the Federation office. If a remittance is sent with the order, the postage will be prepaid. If an invoice is required, the postage will be added. Checks should be made out to the Federation of Sewage and Industrial Wastes Associations.

CONTINUED ON PAGE 15A

"from Chicago"

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AIR DIFFUSION SYSTEM

Patents Pending

. . . induced counterflowing air-liquid streams shear large air globules from nozzles into fine bubbles . . . causing instantaneous oxygen transfer to liquid, from turbulence, and thousand-fold increased air film surfaces.

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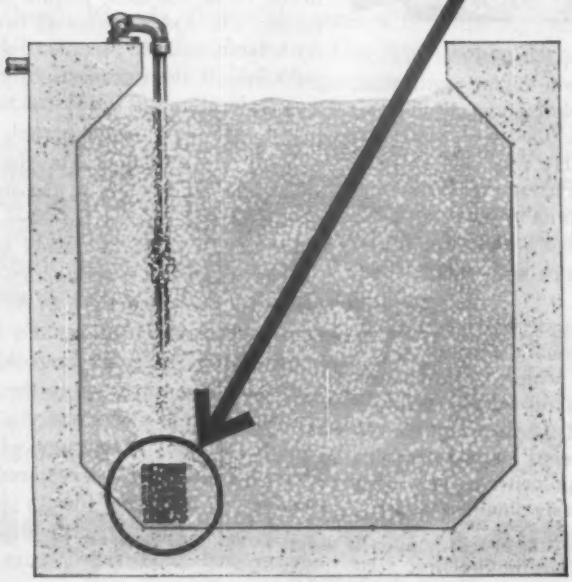

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. . . fine bubble "SHEARFUSER" Air Nozzles, or Porous Diffusers, to obtain required aeration . . . combined with SWING DIFFUSERS for operating flexibility.

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COMPARATIVE SPACE REQUIREMENTS
(Based on data in FISWA Manual of Practice No. 8, 1959)

Population	Average area for open sand beds (square feet)	Average area for complete vacuum filter installation (square feet)
10,000	17,500	950
20,000	35,000	1,400
30,000	52,000	1,900
40,000	70,000	2,250
50,000	87,500	2,650
100,000	175,000	3,500

Vacuum filters using Pennsalt Ferric Chloride to get faster coagulation—and denser, drier filter cake—require as little as 5% of the area of open sand beds. And labor costs are lower . . . odor problems eliminated . . . peak loads more readily handled.

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Washington Viewpoint

A severe cutback in grants for waste treatment works was President Eisenhower's answer—in his budget message—to Congress' obvious intent to put through a much-expanded aid program.

The Eisenhower message requested appropriations of $20 million for fiscal year 1961 (which starts July 1), compared to the $45 million set up for the current year. Said the President: "(the appropriation) represents the maximum amount which I believe is warranted for a construction program which is, and should remain, primarily a state and local responsibility."

Following out his own definitions of areas of federal responsibility, the President asked for increased funds for research and control activities of the Public Health Service, in connection with air pollution, water pollution and radiological health control activities. And he said that the Administration will ask, shortly, for new legislation to strengthen enforcement provisions of the Water Pollution Control Act.

Taking the budget message overall, note two things: of the huge ($6.945 billion) total asked for all federal construction activities, nearly a fifth will go for natural resources construction programs—including development and control of river basins, navigation, irrigation, development of hydro power and water supply.

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Lack of growth in municipal fluoridation programs is beginning to worry the Department of Health, Education and Welfare. In each of the past three years, additional communities adopted fluoridation, but the number so acting has dropped steadily. And overall, the number of people served by fluoridated water has lagged far behind the increases in urban population.

For instance, said HEW, in 1956, 233 communities adopted fluoridation programs for their combined populations of about 7,000,000. In 1959, 97 communities began fluoridation—but 24 other municipalities voted against such programs. And, in the three-year period, 1956-59, urban population increased about 7,500,000, but those served by fluoridated water jumped only 4,200,000.

In a somewhat plaintive statement, HEW Secretary Arthur E. Flemming, commented that he couldn't understand what has been happening, in view of the fact that advantages of fluoridation to preservation of human teeth have been thoroughly and scientifically established, and that most health organizations have urged fluoridation.

(Flemming didn't mention, however, the increasing number of lawsuits that have been filed opposing fluoridation on the ground that it is a violation of the civil rights of citizens who do not wish such medica-

tion. One such suit recently reached the U. S. Supreme Court—but was dismissed on technical grounds.)

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

The steadily worsening pollution of the Great Lakes, source of water supply for more than 14 million U.S.citizens, is coming under close observation by the Public Health Service's Division of Water Supply and Pollution Control.

Tipoff was a speech at Chicago by Arve H. Dahl, deputy chief of the division. Said Dahl: The states haven't been lax, but increasing manufacturing operations, coupled with continued dumping of sewage from municipalities and from ships, is making the situation a serious one.

Action to look for: PHS will expand its sampling stations from 50 to 250; a joint U.S.-Canada commission will tighten its checks; lake states will be pushed to exercise closer control. Behind this action is a really big stick—the power of PHS to flatly order a community or an industry to clean up its waste discharges in the manner that has already been done against Sioux City, Iowa (and 10 meat packers there), and other communities.

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Although no legislative action on this problem seems likely this session, you can make a pretty fair guess right now as to what some of the major recommendations on national water policy will be, once Senator Bob Kerr's select committee is ready to make a report.

As you know, (see January column), the committee has held numerous hearings on water resources problems all around the country, and will hold more in Washington.

And, reading the testimony, the line of questions, and opinions by committee members, you come up with a lineup something like this:

1. Strong support for the Blatnik Bill (HR 3610) to double federal grants for pollution abatement;

2. Speedup in the Agricultural Department's Small Watershed Program (PL 566), and liberalization of benefits considered in justifying these projects;

3. A federal loan program for water supply facilities that would enable municipalities to borrow money for development of sites;

4. More money for research in all phases of water resources development;

5. Broadening of justifications for Reclamation projects to include consideration of recreational, fish and wildlife conservation.

6. A program of public education, by publicity and other means, to propagate the real benefits of proper resources planning.

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Just for the record—in relation to current Congressional-Administration maneuvers concerning more federal aid for pollution control—here's the status of the current program (as of November—latest available):

A total of 1,902 projects have been approved, in all states, in the slightly more than two years the program has been in progress. These represent a total cost of $699.2 million, of which the federal share is $158.3 million. A total of 761 have been completed, 615 are still under construction.

Three low-speed engine-type units installed in new Mill Creek sewage treatment plant.

ideal performance at mill creek

Three IDEAL 1350 kw generators, coupled to 1910 hp diesels, turn at 327 rpm to provide power for pumping, comminution, flocculation, digestion and building lighting at Cincinnati's new Mill Creek Sewage Works. A fourth unit, to be installed prior to completion of the facility, will provide a total capacity of 120 million GPD. It's another example of IDEAL equipment selected for outstanding municipal power development projects where dependable power performance is important.

On the job in similar installations across the land and around the world, IDEAL low and high speed generators in ratings from 10 to 10,000 kw are designed and engineered to meet your exact requirements. You can depend on IDEAL's reputation for quality equipment earned in over a half-century of creative electrical engineering. When your specs say "IDEAL", it's the finest!

EMERGENCY STAND-BY

Typical high-speed unit installed on a diesel generating set in a Midwestern metropolitan telephone exchange. 50, 60 and 400 cycle, 10 to 4000 kw for any requirement.

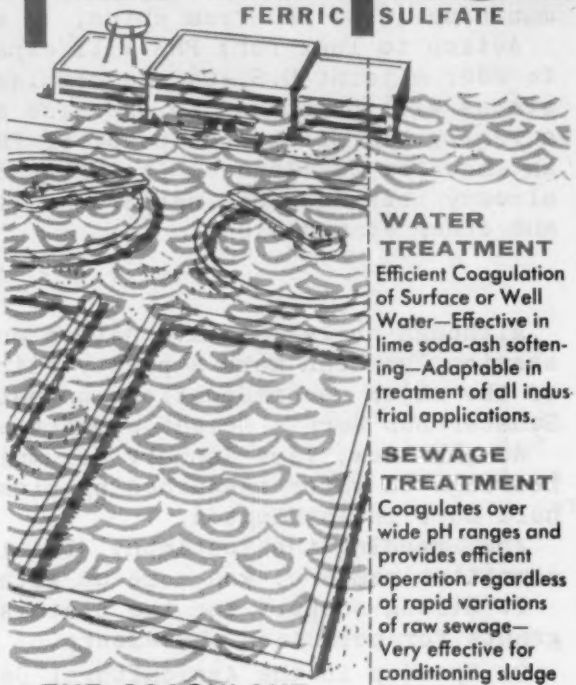
The IDEAL ELECTRIC & MANUFACTURING CO.
323 East First St. Mansfield, Ohio

SINCE 1903, AMERICA'S FINEST MOTORS, GENERATORS, MOTOR-GENERATOR SETS, SWITCHBOARDS AND CONTROLS

ELIMINATE YOUR WATER TREATMENT PROBLEMS WITH . . .

ferri-floc

FERRIC SULFATE



THE COAGULANT WITH THE PLUS FEATURES . . .

Excellent Taste and Odor Control
Increased Filter Runs
Coagulation Over Wide pH Range
Rapid Floc Formation Turbidity Removal
Manganese and Silical Removal
Bacteria Removal Ease of Operation
Efficient and Economical

WATER TREATMENT
Efficient Coagulation of Surface or Well Water—Effective in lime soda-ash softening—Adaptable in treatment of all industrial applications.

SEWAGE TREATMENT
Coagulates over wide pH ranges and provides efficient operation regardless of rapid variations of raw sewage—Very effective for conditioning sludge prior to vacuum filtration or drying on beds.

SODIUM SILICO FLUORIDE—for Fluoridation of municipal water supplies. Available for prompt shipment. Inquiries invited.

FREE BOOKLET Let us send you without charge, a 38-page booklet that deals specifically with all phases of coagulation—just send us a postal card.

TENNESSEE CORPORATION
615-629 GRANT BUILDING, ATLANTA 3, GEORGIA

News—Here & There

CONTINUED FROM PAGE 9A

Operating Report Dist. Of Columbia Treatment Plant

During fiscal 1959 ending June 30th, 1959, the District of Columbia Sewage Treatment Plant treated fifty-one billion gallons of sewage with an average flow of 140.2 mgd, down 24.7% from 1958. Four new aerated grit channels have been placed in operation and relining of raw and settled sewage conduits was completed during the period March 19 to April 24, 1959.

The plant accomplished an average reduction in suspended solids of 49.8% and of five day BOD, 29.6%. Sludge filters operated a total of 187 days producing 6,207.2 tons of dry solids in filter cake.

Visitors from 13 foreign countries, 16 states and the District of Columbia viewed the plant for a total of 269 registered visitors during the year.

CHEMISTRY FOR SANITARY ENGINEERS
By Clair N. Sawyer
McGraw-Hill Book Co., Inc., 367 pp; 1960

The author, an Associate and the Director of Research of Metcalf and Eddy, Engineers, has been a Professor of Sanitary Chemistry at the Massachusetts Institute of Technology for 15 years. Prior to that period he taught at New York University and the University of Wisconsin; so he is certainly qualified to write on chemistry for sanitary engineers.

His writing has been adapted to present-day practice in the education of sanitary engineers, wherein the average student takes an undergraduate degree in civil engineering (including perhaps one year of chemistry) and the "majors" in sanitary engineering at the graduate level. Sawyer's book provides a review of the principles of chemistry that will be useful to the sanitary engineer, and that he may have forgotten in the time elapsed since Freshman chemistry. It also provides a description and explanation of the practical applications of chemistry in sanitary analysis. The book is divided into two main parts for this purpose.

About half of the book is devoted to fundamentals of chemistry for engineers, including concepts from general, qualitative, quantitative, physical, colloid, bio-, and radio-chemistry. The explanations are clear, and should cause no difficulty to a student who has previously studied chemistry, even though he may have forgotten much of it.

The second portion of Sawyer's book describes the major analytical tests useful in sanitary engineering. The reasons for each test are discussed, followed by the chemical principles of the test method. This writing is not intended to replace "Standard Methods," but is certainly a valuable adjunct to that text, especially to one who is not a trained chemist.

In this reviewer's opinion, Sawyer's book is not only a good college text but is also suitable for a program of individual study. It should be on the desk of every practicing sanitary engineer. This is the first in McGraw-Hill's Series in Sanitary Engineering and Science, and is an excellent beginning. CFG

Describe Radioactive Wastes Ground Disposal

Three General Electric scientists described progress being made in ground disposal of wastes from AEC's Hanford, Wash. reactors. Speaking in Monaco at the recent Conference on the Disposal of Radioactive Wastes, R. E. Brown, Senior Geologist at Hanford laboratories chemical effluents technology operation, explained more than 12 years and nearly 200 man years of time have been spent studying radioactive wastes in the Hanford ground and groundwater. Efforts are to further general knowledge of waste behavior, decrease disposal costs and increase the safety factor, he said.

Some geologic and groundwater evaluations are unique to the 300 square miles of concern at Hanford, but most are applicable to other sites, according to Brown. Drilled wells provide basic exploratory and research methods and structures, with 550 wells totalling 105,000 feet in depth have been drilled at Hanford since the waste disposal research program began in 1947. Wells assist greatly in studying geologic features which affect groundwater movement.

Dr. D. W. Pearce, manager of the chemical effluents technology operation at Hanford, said that broadened knowledge of radioactive wastes reactions with soil minerals is being gained from studies in geology, hydrology, minerology, soil chemistry, analytical chemistry and process engineering. Long soil column experiments, closely simulating actual underground conditions, indicate slower waste material break-through than was predicted from laboratory tests with short soil columns.

Field experiments include use of a model "crib" (disposal facility) to study spread of radioactive waste materials beneath a ground disposal site. Findings indicate this disposal means may be of greater benefit than previously assumed. Natural surface depressions, "swamps", receive large volumes of normally uncontaminated process cooling water. Highly radioactive wastes are stored in large underground tanks where they cannot escape to the environment.

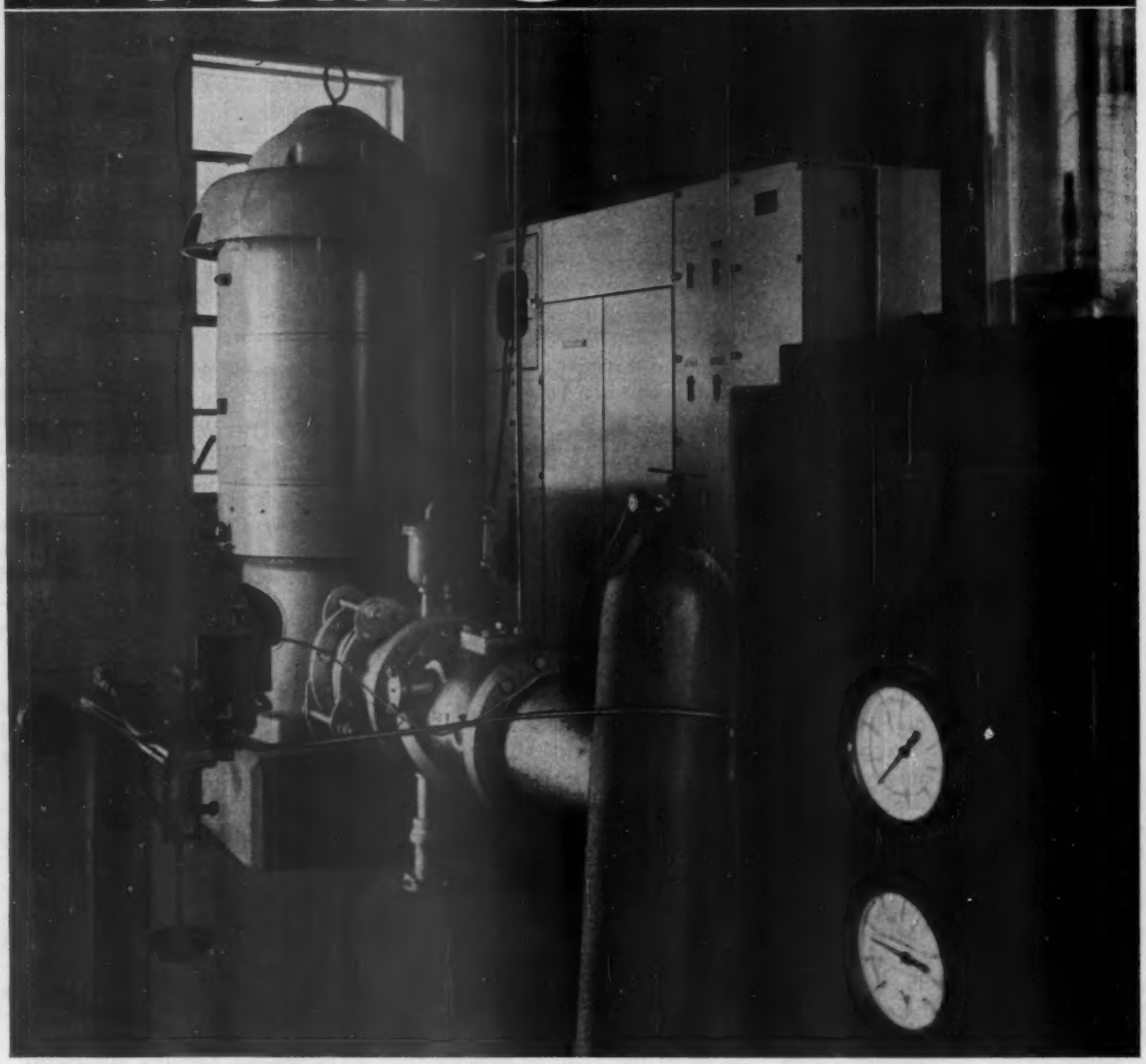
J. F. Honstead told the Conference that three main systems are utilized in disposing of low and intermediate level wastes at Hanford:

1. Ability of soil to adsorb and immobilize the radioactive elements.
2. Waste discharge into environmental materials providing dilution to levels of no concern.
3. Waste injection into paths long enough to allow suitable radioactive decay before materials reach a populated domain.

Proceeding Copies Available

The Manufacturing Chemist Association announces that proceedings of the 1959 Air & Water Pollution Abatement Conference held March 18-10, 1959 in Cincinnati has been published. Included are 11 papers presented at the Conference together with all pertinent charts, graphs and illustrations. Copies of the 161 page book are available from Manufacturing Chemists Association, Inc. 1825 Connecticut Avenue, N. W. Washington 9, D. C. at $2.00 each.

DEMING VERTICAL TURBINE PUMPS



This is a Deming Vertical Turbine Pump installation that puts dependable performance into water works operation! Water works and consulting engineers select and specify this pump because they're "Performance-Minded" and a Deming Vertical Turbine Pump meets this requirement. Deming Vertical Turbines are available for use with any type of power drive in a wide range of capacities to meet your specific requirements.

For Further Information Write for Bulletin 4700A

The DEMING Co.

288 BROADWAY • SALEM, OHIO

Equipment News

Synthetic Flocculant Produced

201

Dow Chemical Company, Midland, Mich., has announced the availability of its Purifloc N17, a synthetic high purity flocculant produced especially for use in the treatment of potable water.

Recently cleared for use in potable water by the United States Public Health Service, Purifloc N17 is described as a "synthetic, high molecular weight flocculant with high activity for many types of suspended solids normally found in natural waters and produced by chemical treatment."

Suggested applications of the new product include its use as a primary coagulant for pre-sedimentation, conventional and high rate (sludge-blanket) water treatment plants; as a coagulant aid to enhance the activity of primary flocculants such as alum and ferric sulfate; as a coagulant or coagulant aid in chemical water softening operations to reduce the load of suspended solids to the filters; and as a clarification aid in the design of rapid sand filters to operate at increased hydraulic rates yet producing equal or better water quality.

Because of its high activity, only small quantities of Purifloc N17 are required to achieve a high degree of particle agglomeration. A concentration of one part per million is recommended by the manufacturer as a practical maximum for most applications.

Small Package Dredge for Municipal Use

202

Morris Machine Works, Baldwinsville, N. Y., responding to increased demand for a small suction dredge, has developed a dredge package for use in both municipal and industrial water supply areas, shoefronts, rivers, channels or any area where the removal of mud, silt, sand or gravel is a problem.

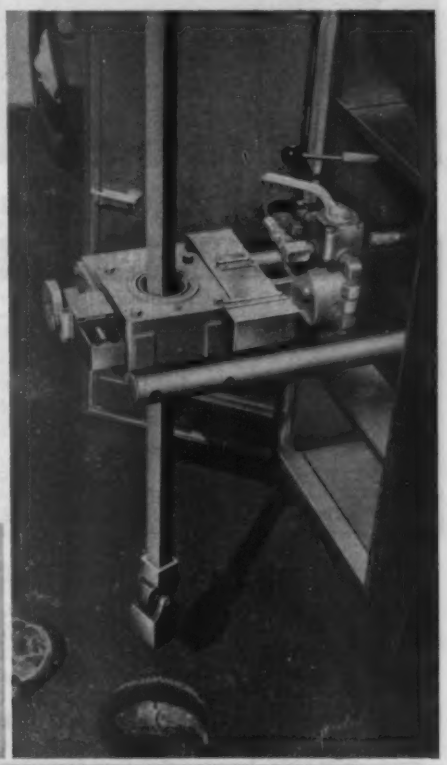
The complete package consists of: a Morris CK pump; either a gasoline, diesel or electric power unit; a V-Belt drive, complete; pump fittings; exhaust primer and fuel tank for gas or diesel units; gauges; a gland water

pump and drive; and the complete unit mounted on a structural steel sub-base.

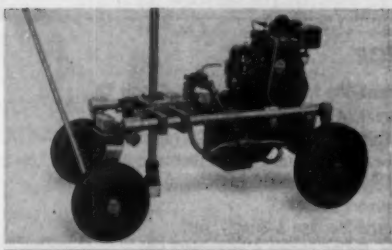
In addition, this complete package is arranged so that it can be easily placed on the purchaser's own hull or barge. The unit is available in 6", 8", or 10" pump sizes, with the power units furnished in accordance with the particular application.

CONTINUED ON PAGE 19A

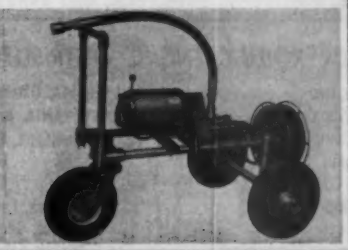
HYDRAULIC TRUCK MOUNTED VALVE OPERATORS PROVIDE ONE MAN CONTROL OF VALVES FROM 10" TO 60" SHIPPED FULLY ASSEMBLED, FOR MOUNTING IN ANY MAKE OF TRUCK BY YOUR OWN MECHANICS, WITHIN A FEW HOURS. HAS SAFETY DEVICE FOR DAMAGE PROTECTION ALSO POSITION INDICATOR.



PORTABLE 3-10 HP.



ELECTRIC DRIVE



Makes EVERY VALVE Power Operated.

Payne Dean & Co.
Clinton, Conn.

ROILINE ENGINES (Formerly LE ROI)

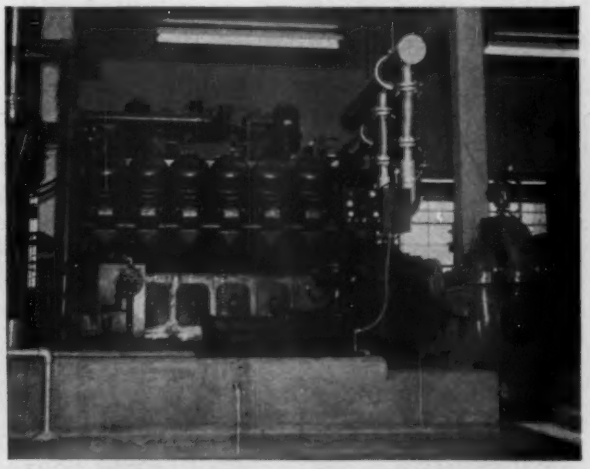
* The trade mark LE ROI is used under license from Westinghouse Airbrake Co., the trade mark owner.

POWER FOR MUNICIPAL PLANTS

Three ROILINES pull the pumps at Oklahoma City's Lake Hefner Municipal Filtration Plant.

Model F-1500, maximum horsepower 215 at 1200 rpm on natural gas.

Model L-3460, maximum horsepower 595 at 1350 rpm on natural gas.



BASIC ENGINE CHARACTERISTICS*

GASOLINE OR NATURAL GAS					600	800	1000	1200	1400	1600	1800	2000	2200	2400
MODEL	Bore & S.	Cyls.	Displ.	Torque—rpm	BRAKE HORSEPOWER AT ENGINE SPEEDS INDICATED									
H540	4½ x 4¼	8	540	430- 900	...	64	82	99	115	130	143	155	164	170
H844	5¼ x 4⅞	8	844	637-1500	...	106	135	165	191	215	237	255	270	278
F1500	6¾ x 7	6	1503	1090- 650	125	165	200	215						
H2000	6¾ x 7	8	2004	1485- 650	170	225	270	290						
L3000	6¾ x 7	12	3006	2200- 650	250	335	405	435						
L3460	7¼ x 7	12	3468	2570- 900	285	391	492	568	595 @ 1350 RPM					
L4000	7.54 x 7.5	12	4000	2930- 900	325	446	560	645						

*With oil pump, water pump, magneto, air cleaner, carburetor, and exhaust muffler. Hp shown is maximum.

SEE YOUR ROILINE ENGINE DISTRIBUTOR

ARIZONA, Casa Grande, Engine Service Company, Inc.
ARKANSAS, Paragould, Wonder State Manufacturing Co.
CALIFORNIA, Long Beach, Engine & Equipment Company
COLORADO, Denver, Emrick & Hill Engine & Equipt. Co.
KANSAS, Garden City, Carson Machine & Supply Co.
LOUISIANA, New Orleans, Southern Engine & Pump Co.
MICHIGAN, Reed City, Hafer Engine Company
NEW YORK, Syracuse 6, J. C. Georg Corporation
OHIO, Columbus 19, Cantwell Machinery Company
OKLAHOMA, Oklahoma City 9, Carson Machine & Supply Co.
PENNSYLVANIA, Bradford, R. R. Reck Company
TEXAS, Houston 1, Southern Engine & Pump Co. (also in Beaumont, Corpus Christi, Dallas, Edinburg, Kilgore, San Antonio)
Lubbock, Farmers Supply
Odessa, General Machine & Supply, Inc.
Wichita Falls, Nortex Engine & Equipment Co.
WYOMING, Casper, Emrick & Hill Engine & Equipt. Co.

424-B-1

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. / **New York • Tulsa • Los Angeles**
Factories: Waukesha, Wisconsin and Clinton, Iowa

Equipment News

CONTINUED FROM PAGE 17A

Valves for Reducing and Regulating Pressure

203

A. W. Cash Valve Manufacturing Corp., Decatur, Illinois, has recently made available a new series of pressure reducing and regulating valves that are recommended for use with air, oil, water, gases (except steam) and all non-corrosive fluids.

Designated the Type A-360 and A-361 Series, the valves incorporate a balanced piston design so that the outlet pressures are not affected by wide variations in the inlet pressures or by variable rates of flow.

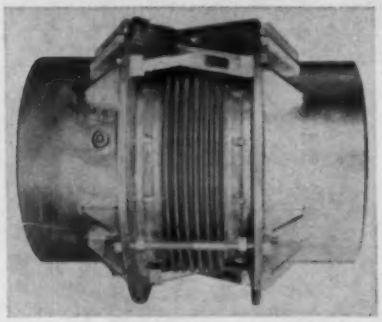
All sizes of the Type A-361 series are designed for three or four way usage: having one inlet and three outlets; or two inlets and two outlets. This series has all bronze bodies and are available in ¼, ⅜, and ½ inch sizes.

All of the new valves can be furnished with or without built-in bleeders, and are available with a "T" handle, and a wing nut and bushing for panel mounting. The valves will operate from 2 to 175 psi at maximum temperatures of 200° F.

Hinged Expansion Joints Makes Lines Self Supporting

200

Zallea Brothers, Wilmington, Delaware, recently introduced a hinged type expansion joint for piping sys-



tems that, because of their size or location, cannot be supported or anchored by conventional means.

These hinged joints allow a piping system to be entirely self supporting, and thus eliminate the need for additional supports and reduces pipe line bending stresses. Shear loads can be carried by these units which can also absorb piping weight, wind loads, and other dead loads without extensive anchorage.

The standard model of hinged expansion joint is designed to take rotation in one plane only. For this reason, the joints are used in combinations of two or three. Slotted hinges are available for special applications where axial movement must be permitted, but these units do not absorb axial pressure thrust.

Copper and Brass Tubing Tools Developed

204

Toledo Pipe Threading Machine Co., Toledo, Ohio, has recently added a full line of copper and brass tubing tools to its regular line of hand and power pipe tools.

Now available in this new line are four types of cutters for hard or soft copper, brass or aluminum, block

CONTINUED ON PAGE 23A

ERP At Work

This quiet scene should not mislead. Electro Rust-Proofing *is* hard at work. There's no hustle or bustle . . . just dependable, continuous cathodic protection.

Underneath this water an ERP-engineered protection system fights rust—fights maintenance costs. The battle was joined before installation. ERP Engineers surveyed the plant . . . designed and installed a system that gives maximum protection at lowest cost. And now ERP Service follows up. Continuous protection is assured . . . maintenance costs are the lowest ever.

If you want to stop trouble before it starts, if you want to protect your investment in steel structures—quietly, efficiently, economically—use Electro Rust-Proofing Systems. ERP is preventive maintenance at work.

We'll be glad to send more information. Write Dept. E-51.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.

A SUBSIDIARY OF WALLACE & TIERNAN INC.

30 MAIN STREET, BELLEVILLE 9, NEW JERSEY

CABLE: ELECTRO, NEWARK, N. J.

"K&M" ASBESTOS-CEMENT SEWER PIPE

INFILTRATION-PROOF AT 25 PSI PRESSURE

Tests prove that the exclusive, patented "K&M" FLUID-TITE Coupling maintains a permanently infiltration-proof seal under severest field conditions.

This is true even when "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe is under deflection, or is buried at various depths under heavy backfill. Tests prove this infiltration-proof pipe can withstand 25 psi external water pressure.

In addition to its tight sealing, "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe is non-corrosive and completely immune to electrolysis. Its bore—with a Manning Factor of n-0.010—remains smooth and clean for full, unobstructed flow.

That's why there's a minimum of maintenance with this hardy pipe. It reduces treatment loads and costs. Requires fewer periodic inspections and cleanings.

There are five classifications of "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe to meet your crushing strength requirements. To simplify planning and design.

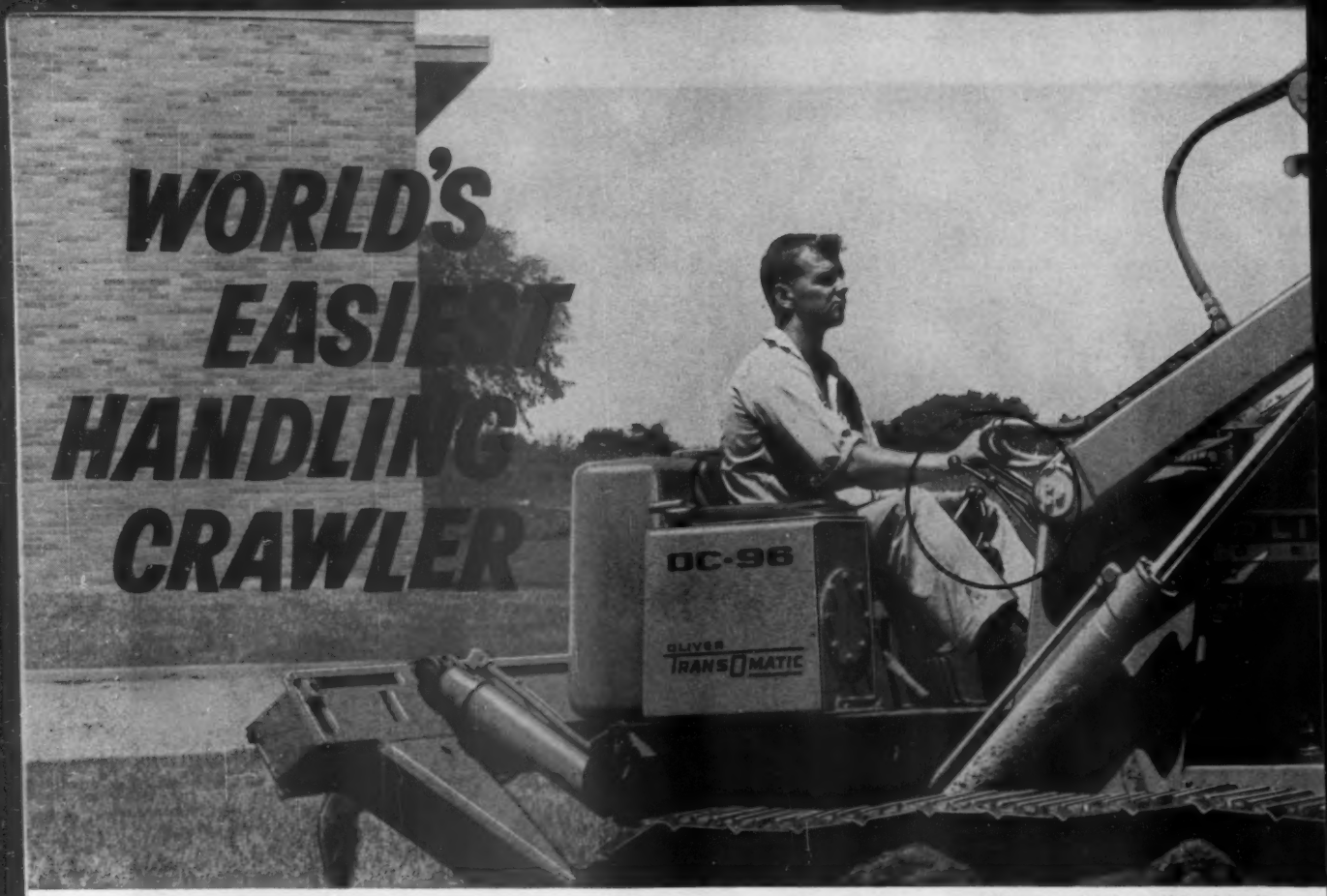
Eliminate the problem of infiltration with tested and proven "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe. Write to us today.

5 CRUSHING STRENGTHS OF "K&M" ASBESTOS-CEMENT FLUID-TITE SEWER PIPE

Size Inches	Class 1500	Class 2400	Class 3300	Class 4000	Class 5000
6	1500	2400	3300		
8	1500	2400	3300		
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	1500	2400	3300	4000	5000
16	1500	2400	3300	4000	5000

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA



62 gross engine h.p. with 1-yd. loader

Take the controls of a new Oliver Trans-O-Matic OC-96 Loader —and "let the tractor do the talking!"

Power shifting plus power steering (with three types of turns) makes the startling difference! The OC-96 is *so easy* to operate, it simply cannot be compared with older designs on this count—*or any other!*

You sit in a spacious, foam-rubber seat (offset for ideal visibility)...have full-freedom leg room in the wide, flush-deck compartment.

As for the controls, they're practically "in your lap." Levers for *power* steering, *power* reverse and *power* shift are placed directly ahead of the seat. Your arms are in "resting" position all the time. To brake or foot-steer, pedals do the job just as effortlessly.

Easy operation, indeed! The *easiest* you ever had—plus.

NEW! 3 types of power turns—The only crawler its size giving you counter-rotation turns for about-faces in the tractor's own length—also spot turns and gradual turns.

NEW! Power shifting—Shift from forward to reverse instantly, on the go. No clutching, no gear-clashing with Oliver's all-hydraulic Trans-O-Matic transmission. Four speeds in high or low range—forward to 6.05 m.p.h., backward to 8.07 m.p.h.

NEW! Torque converter—The OC-96 has heaviest-duty torque converter (not automotive kind)—delivering full engine power for digging and crowding in fastest non-stalling operation. Advanced 62 gross h.p. diesel.

NEW 1-yd. loader design—See how the OC-96 is an *integral* tractor-loader minus high, hung-on parts and cross members. Loader side pedestals are actually part of the tractor for low profile, high stability, finest visibility and safety. Fast breakout, greatest dumping reach. No other its size has such rapid work cycle—is so rapid-reversing.

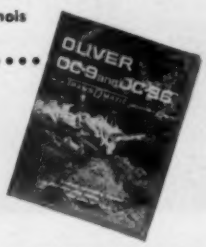
LOOK TO OLIVER FOR YOUR BEST BUY IN WHEEL AND CRAWLER TRACTORS

THE OLIVER CORPORATION

Dept. 2232, 400 W. Madison St., Chicago 6, Illinois

"Easy operation? Man, this OC-96 is the easiest I've ever seen!" "There has never been a crawler-loader like it for speedy, easy handling," says Lee Bruce of L. H. Bruce and Son, Middleton, Wisconsin.

On this big grading and loading assignment for a University of Wisconsin 2½-million-dollar student housing project, the OC-96 hustled the entire job. Six-yard trucks were put on a 2½-minute loading cycle. Counter-rotation turns cut time and working distance, permitted trucks to be spotted closer.



NEW CATALOG—"must" reading for cost- and comfort-conscious tractor users.

Equipment News

CONTINUED FROM PAGE 19A

tin and lead tubing in sizes from ⅛ to 4⅛ inches. Six flaring tools covering the range of sizes are also available. All have hard chrome finished cones and a slip-on yoke feature.

In addition, a combination flaring tool and swaging tool, with four swage adapters, complete in a metal case, is now offered, besides a regular swaging tool. The line also includes seven, lever-type tube benders, for sizes from ¼ through ⅞ inches; a set of five spring benders for sizes from ¼ through ⅝ inches; and an inner and outer reamer.

Self Priming Solids Handling Pump

205

Gorman-Rupp Company, Mansfield, Ohio, have announced the addition of Model 12B2, with a 2-inch suction and discharge, to its line of self-priming centrifugal solids handling pumps.

The pump features an exclusive impeller design that permits the passing of spherical solids to 1⅛ inch in diameter. Other features include a removable endplate for quick and easy inspection and maintenance of the pump, and a renewable wearplate.

The pump may be mounted high and dry above the sump with only the suction end in liquid. Its capacities range from 40 to 220 gpm and is also available in 3, 4, and 6-inch sizes.

Valve Designed for Silent Operation

206

Aerojet-General Corporation, Azusa, California, has designed and made available a new, Silent Valve, that virtually eliminates aeration, cavitation, surging, vibration and the resultant noise, and undesirable physical phenomenon associated with the rapid flow of fluids.

The unit incorporates a new principle of flow control that was originated and developed by the company's Anti-Submarine Warfare Division. Variable in size and scope, the valve can be supplied for installation in systems with line sizes from 1-inch to many feet in diameter, and handling a wide variety of fluids.

The heart of the valve is a cylindrical plug of elastomer having a large number of axially aligned holes which serve as flow passages. This plug is

CONTINUED ON PAGE 29A

HOW WOULD YOU VOTE?

The growth of American industry and agriculture, the rise in standard of living, war-caused shortages of materials, the high cost of economic inflation, all have combined with public indifference to create a 30-year-period of delay in water works improvements... a situation now serious, and which could become tragic.

Since most water works now are public utilities, they are also a public responsibility. Capable men are employed to manage them, but the public must finance them. A water works utility economically may be and usually is a non-profit organization. But like other business operations, it encounters problems of plant maintenance and depreciation and demands for increased service or production. If low water rates have prevented accumulation of financial reserves now needed for improvements, the answer probably is a revenue bond issue.

If such a bond issue election were to be held in your town today, how would the public vote? The fate of America's sorely needed water works improvements rests with the public.

This Series is an attempt to put into words some appreciation of the water works men of the United States.

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

DON'T BE FOOLED BY INITIAL PIPE COSTS...

Certain factors concerning the type of pipe to be used for a proposed water or gas project must be examined carefully:

First
—how much does the pipe cost, compared to other types?

Second
—how often will it require repair?

Third
—how long before it has to be replaced?

After all, how much money do you really save if you buy the cheapest pipe . . . then have to repair it frequently . . . and *then* have to replace it within a decade or two?

You save with cast iron pipe

Sometimes the first cost of jobs where cast iron pipe is specified, is higher than similar projects using cheaper pipe. Yet, in the long run, cast iron pipe costs *less!* Here's why:

- Cast iron pipe rarely requires repairs. Its rugged construction, corrosion-resistant qualities and bottle-tight rubber-ring joints will withstand the most severe pressures. Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.

- Cast iron pipe is built to *last*—98 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! In fact, in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Once cast iron pipe is in the ground, it stays there!

Don't be fooled by "low-cost" pipe. Insist on the pipe that will actually save you money over a period of years . . .

In Nebraska—Here a section of cast iron pipe is being relocated. Twenty-five years old, the pipe is still in excellent condition—has never required major repair . . . or replacement.

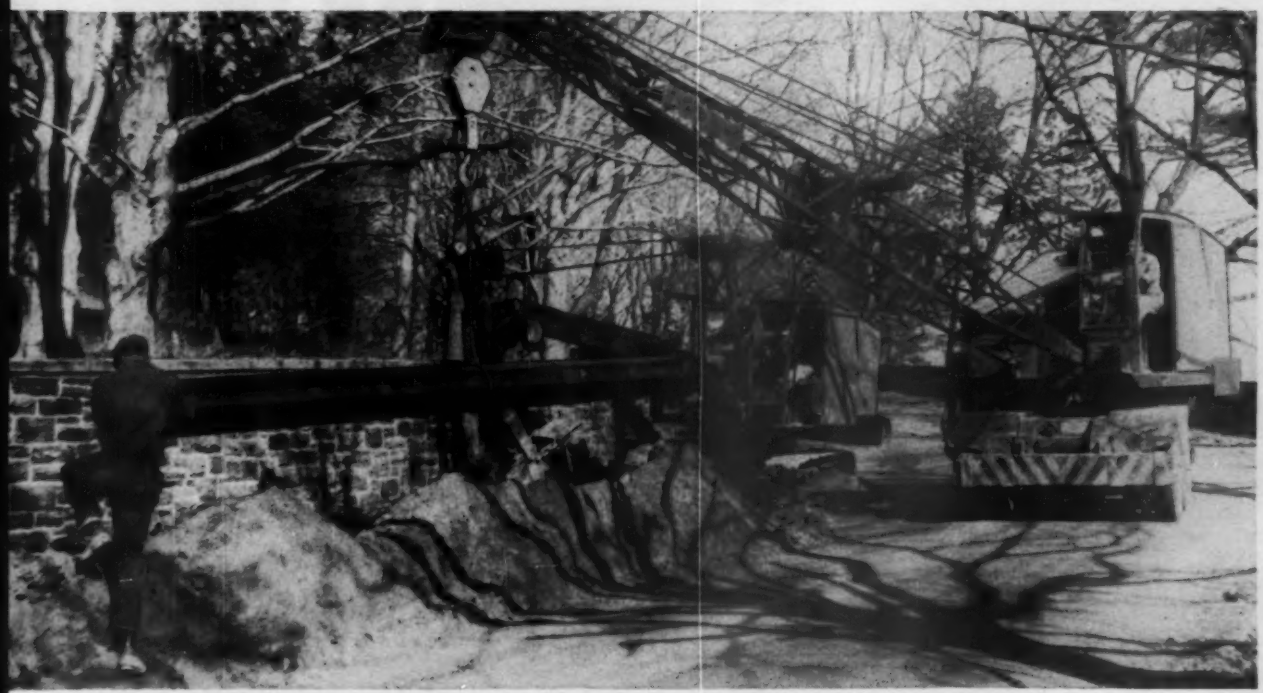
Rely on CAST IRON PIPE

In Indiana (above)—"All-weather" cast iron pipe is quickly installed despite wet trench conditions. Slip-on joints were easily assembled, with one workman using a crowbar.

In Kansas (above)—36" cast iron water main. Another part of this main was floated out of its trench by a heavy downpour. Later a 150 psi water test revealed no leaks in the slip-on joints!

In Pennsylvania (below)—This 16" cast iron pipe is being installed as fast as the trench hoe can prepare the trench.

Handy lengths and slip-on joints make cast iron pipe easy to handle, even in crowded neighborhood sectors; require less labor.



CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director, 3440-E Prudential Plaza, Chicago 1, Illinois

NATIONAL
WELDING CO. LTD
CONTRACTORS TO THE
PROCESS INDUSTRIES

BEACONSFIELD, QUE. SCORES WORLD PREMIER WITH AST, "FIRST RADICALLY NEW APPROACH TO THE SANITARY SLUDGE PROBLEM IN A HUNDRED YEARS"*

On Monday evening, November 30th, the Town Council of Beaconsfield, Que., officially accepted its AST (Atomized Suspension Technique) reactor, first installation of its kind in the world. The action of the Beaconsfield Council heralds sweeping advances in sewage disposal by Canadian, U.S. and foreign communities. The Beaconsfield AST unit, employing the revolutionary process developed by the Pulp and Paper Research Institute of Canada, was designed, built and put through "shake-down" operation by National Welding Co. Ltd.

***** *H. W. Lea of Montreal, Consulting Engineer to the Town of Beaconsfield and many other communities, upon acceptance of the Beaconsfield AST plant was quoted by the Pulp and Paper Research Institute of Canada as follows:*

"This AST procedure, pioneered at the community scale through cooperation between the Town of Beaconsfield, National Welding Co. Ltd., of Montreal, and the Pulp and Paper Research Institute of Canada, is the first radically new approach to the sanitary sludge problem in a hundred years.

"When National Welding offered to risk the cost of putting in an AST plant at Beaconsfield on a pay-for-only-if-successful basis, I recommended that the community go along with an experimental trial which seemed to have a high probability of success. It has now been established that AST can dispose of the sludge on a reliable day-by-day basis.

"The simplicity and compactness of the AST plant are two of its most attractive features. It reduces by one-third the land area needed for a conventional primary treatment plant. And, depending upon foundation conditions at the site, there may be material savings in the cost of installation by using AST. Automatic operation minimizes the need for operating personnel. I shall now, with confidence based on experience rather than on faith, recommend that other communities with a sewage treatment problem consider the AST process. Indeed, I have already done so."

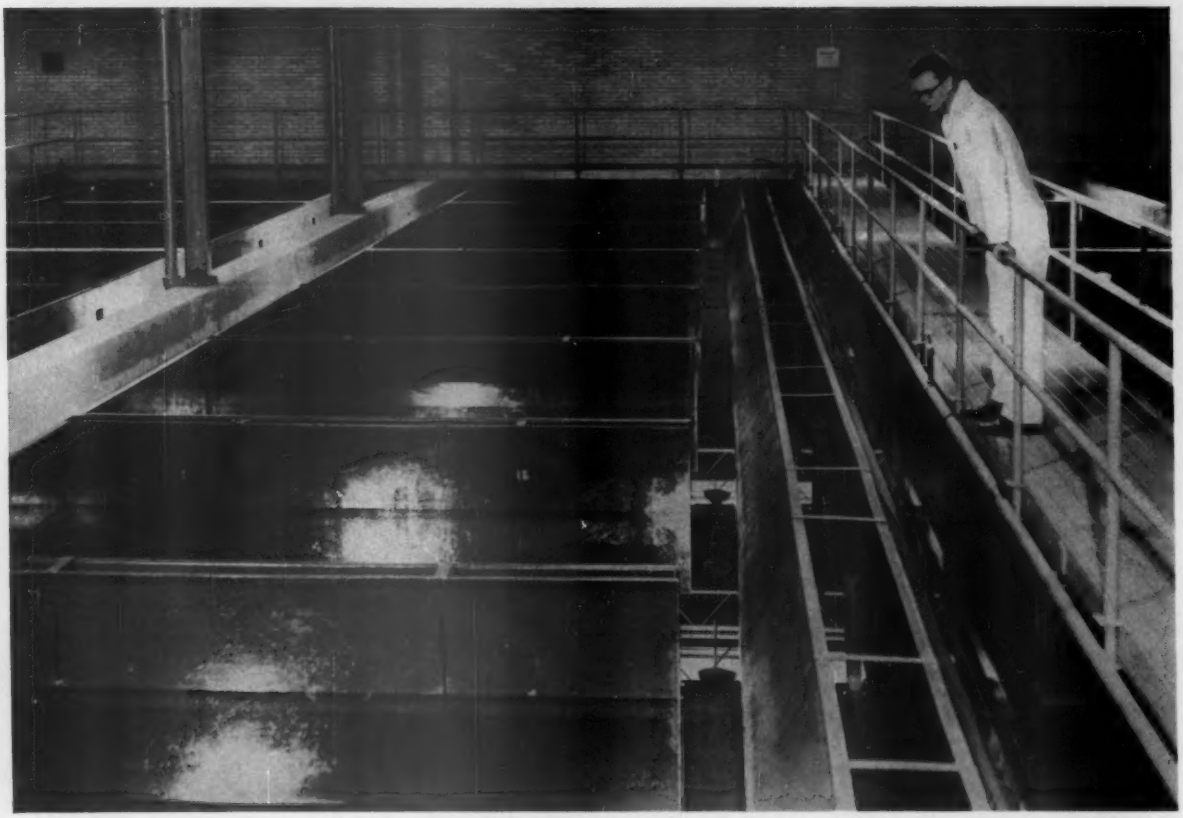
National Welding, the only firm with actual experience in the design and construction of community AST plants, invites inquiries from Canadian and U.S. communities and their consulting engineers.

AST DIVISION

NATIONAL WELDING CO. LTD.

8235 Mountain Sights Ave. • Montreal, Que. • Telephone: REgent 9-3241

FLUIDICS* AT WORK



SPACE SAVER. Permutit Horizontal Precipitators take only 25% as much space as would be needed by conventional basins at the Town of Tonawanda Water Treatment Plant, Tonawanda, N. Y.

How to get the capacity you need in the space you can afford

When the booming town of Tonawanda, N. Y., decided to build its own water treatment plant, space was a major consideration.

The solution as proposed by Nussbaumer, Clarke and Velzey, Consulting Engineers, was to install four Permutit Horizontal Precipitators.

Each unit measures 31'6" x 95' x 16'3" and is designed to handle four million gallons per day with a two million gallon overload. Proved in operation for more than two years, this system efficiently treats 24 million gallons per day.

And this huge load is handled using only one-fourth the space that would have been required if conventional basins had been used.

Space is just one saving you can make with Permutit Precipitators. You'll also find that treatment efficiency is increased, and that often there's a reduction in chemicals and coagulants required.

If you'd like more information about the efficiencies possible through the use of Permutit Precipitators, write for Bulletin No. 2204C.

Or, for a brief introduction to the full line of Pfaudler Permutit equipment for water and waste treatment, ask for the bulletin entitled "An Outline of Modern Water Treating Equipment." Address your inquiries to our Permutit Division, Dept. WS-20, 50 West 44th Street, New York 36, New York.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

Equipment News

CONTINUED FROM PAGE 19A

contained in a tubular housing between two perforated plates, one of which is either mechanically or hydraulically actuated to compress the elastic insert.

As the plug is compressed, the flow passages are reduced in diameter, thereby throttling the fluid flow. At full compression, these channels are closed and complete shut-off is attained. Extremely fine gradations of throttling resistance assure precision flow control over the complete range of operating positions with a minimum pressure loss when the valve is open.

The use of a large number of small diameter flow passages permits the energy associated with large pressure drops to be dissipated smoothly by fluid friction within the tiny channels. Dynamic underpressures are virtually eliminated from the throttling process.

Vernier Caliper Designed for Readability

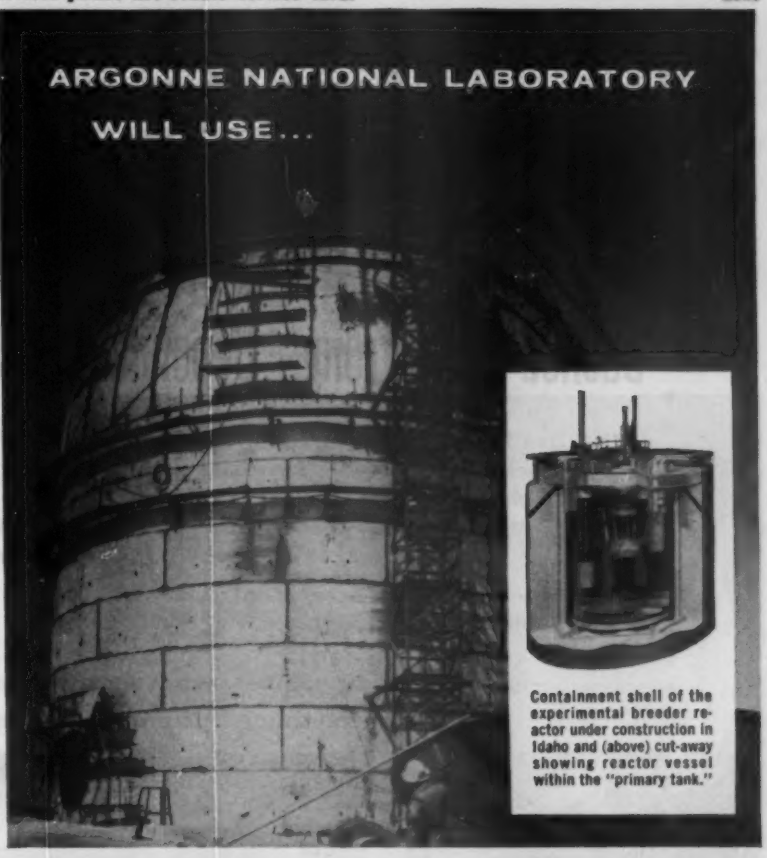
207

Scherr-Tumico Company, New York, N. Y., is offering its new 193 Mauser vernier caliper designed to make reading easier, faster and more accurate. The instrument eliminates the parallax of the standard type vernier by using a flush type design.

In addition eye strain has been reduced by using a lustro chrome finish on both scale and verniers; this latter part has been doubled in length to provide greater accuracy.

Should recalibration and adjustment be needed on either the lower or upper vernier, both vernier plates can be independently adjusted (to .020″). A fine, cam-lock adjustment is provided for easy setting at close limits.

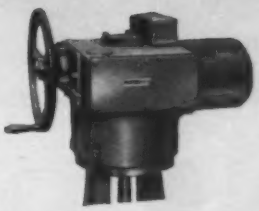
CONTINUED ON PAGE 31A



Containment shell of the experimental breeder reactor under construction in Idaho and (above) cut-away showing reactor vessel within the "primary tank."

ELECTRODYNE®
AUTOMATIC VALVE / CONTROLS

FOR EXPERIMENTAL
BREEDER REACTOR IN IDAHO



Electrodyne will be used by the Argonne National Laboratory as the control for the reactor vessel cover hold-down mechanism in the new experimental breeder reactor EBR II at the National Reactor Testing Station near Idaho Falls, Idaho.

EBR II is a "closed cycle" power plant, where nuclear fuel will be employed to produce heat and at the same time make additional fuel by a "breeding" process. The partly spent fuel and the new fuel that has been bred can then be reprocessed and refabricated into new fuel elements right in the EBR II facility.

Electrodyne is an integral part of the EBR II design controlling the hold-down mechanism for the cover of the fuel chamber which will be submerged in liquid sodium. This reactor has been planned to demonstrate the "breeding principle" that more fuel (plutonium) can be bred from uranium-238 than is used up while the reactor is operating. EBR II has been designed to produce usable electricity from atomic energy.

For customer applications, *Electrodyne* thrust limiting features assure positive, automatic control and complete safety in the handling of the most critical materials.

This again illustrates the versatility of *Electrodyne* as a valve-type control for a wide variety of applications in chemical and power plants, oil and gas industries and water and waste treatment installations.

For detailed information about *Electrodyne*, get in touch with your local *Electrodyne* representative or any valve manufacturer.

HUPP AVIATION Division
6633 WEST 65th STREET • CHICAGO 38, ILLINOIS

ELECTRODYNE VALVE CONTROLS . . . HYDRO-ID GEAR PUMPS AND MOTORS . . . PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE GEARING AND COMPONENTS

American-Made

CAST IRON PRESSURE PIPE

Backed by Strong, Dependable, Responsible Companies

Cast Iron Pressure Pipe produced in America today is backed by responsible companies with long established reputations for quality products ... for proved integrity and dependable supporting service.

These priceless intangibles are added guarantees of the long-lived performance and long term economy of *American-made* Cast Iron Pressure Pipe.

No such guarantees are available to buyers of so-called "bargain" foreign pipe, whether cast iron or cheaper substitutes. If foreign pipe fails, it's the buyer's loss.

–and finally, remember–what America makes, makes America!
Buy pipe that helps create prosperity over here.

1816 MONTREAL, CANADA — 10" Water Main

1828 LYNCHBURG, VA. 7" Water Main

1830 PHILADELPHIA, PA. — 6" Water Main

1834 READING, PA. — 4" Water Main

1831 RICHMOND, VA. 8" Water Main

Early Cast Iron Pressure Pipe, like this, has been in service for a century or more in 68 American cities. Today's American-made Cast Iron Pipe is even better because of improved manufacturing methods, production standards and rigid metallurgical and laboratory controls. You can buy it with confidence in the efficiency of its service and the integrity of its makers.

This advertisement is published in the interests of the Cast Iron Pressure Pipe Industry by .....

WOODWARD IRON COMPANY
Since 1882
WOODWARD, ALABAMA

Equipment News

CONTINUED FROM PAGE 29A

The new caliper is made entirely of stainless steel, hardened throughout. Designed for outside, inside and depth measuring, it has a maximum capacity of 6¼ inches with .001 inches on both lower and upper scales, and an overall length of 9⅛ inches.

Heavy Duty Flange Spreader

208

Wm. L. Riggs Company, Tulsa, Oklahoma, recently introduced a heavy duty model of its Safety Boy flange spreader which will accomodate ASA ring joint flanges. The new model, No. 104, will handle ASA ring joint flanges 150 lbs. through 1500 lbs. in pipe sizes ranging from 8 inches through 24 inches.

Tests have indicated that the product, which uses pressure from the ratchet handle to force a circular cam wedge between the flanges, is a safe and quick way to spread pipe flanges, and to insert blinds, gaskets or orifices.

Butterfly Valve Designed For Easy Replacement

209

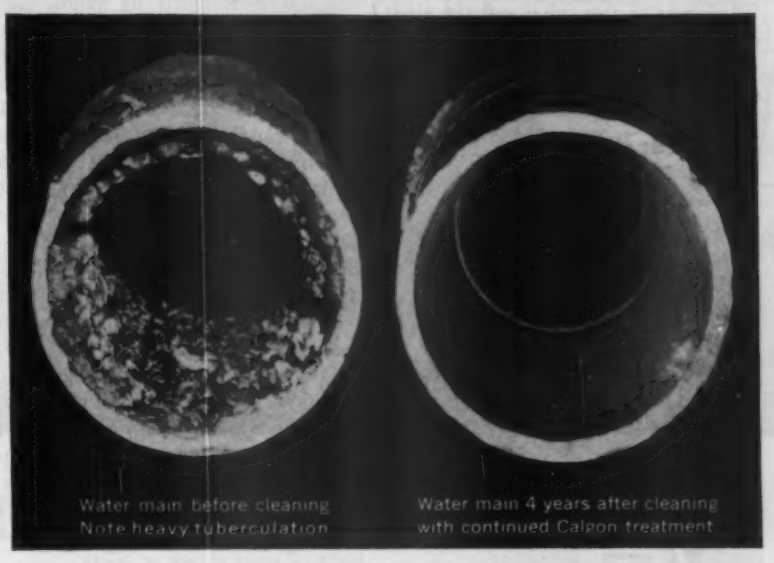
Allis-Chalmers Company, Milwaukee, Wis., has developed a new cart-

ridge type butterfly valve designed for quick and easy replacement. The cartridge unit consists of a standard

CONTINUED ON PAGE 32A

CALGON KEEPS FLOW RATES CONSTANT AFTER MAIN CLEANING

in 4-Year Portland Water District Test


Water main before cleaning
Note heavy tuberculation
Water main 4 years after cleaning
with continued Calgon treatment

Part of the Portland, Maine, Water District System supplies Sebago Lake water to Gorham Village. An 11,000-foot, 8-inch main was the main feed between a booster station and a standpipe at the far end. This main had not been cleaned for 20 years, and it was found that the flow coefficient "C" had dropped to between 50 and 56 due to massive tuberculation.

Replacement or reinforcement of this main would be expensive, so it was decided to try cleaning a 4,000-foot section of the main, and use this as a test section to determine the effectiveness of chemical treatment to retard corrosion. Calgon® and Calgon® Composition TG were chosen for this test.

HERE ARE THE RESULTS:

Pipe line coefficient, raised from 56 to 120 by cleaning, *has remained at this level for four years with Calgon and Composition TG treatment.*

No red water complaints.

Labor and chemical costs, in relation to replacement or reinforcement of the main, *have been minor.*

A complete description of this carefully controlled test, with prescribed dosages and methods, is available—ask for Reprint No. 420-12-6. For information on how Calgon chemicals and Calgon know-how can help you, write or phone:

CALGON COMPANY
HAGAN BUILDING, PITTSBURGH 30, PA.

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

Equipment News

CONTINUED FROM PAGE 31A

butterfly valve in a wedge shaped body which is inserted in the outer body and held in place with the cover. Its flow characteristics are identical to the standard two flange valve.

If necessary, the wedge shaped insert can be removed without disturbing the line flanges or the piping. The cover of the valve and the shaft extension accomodate standard manual, diaphragm, motor or cylinder operators.

New Gear Drive for Pump Motors

210

Johnson Gear and Manufacturing Co., Ltd., Berkeley, California, have introduced the Redi-Torq, a new automatic, combination right angle gear drive designed for use with dual

engine-motor driven, vertical pumps of water works, sewage plants and fire protection systems.

The Redi-Torq permits the testing of an engine from idle to operating speed without interfering with pumping operations. Any control system where electric power failure initiates engine starting will operate this new product.

Installation may be a simple operation because flexible shafting or couplings can be used between the engine and the gear drive; an engine clutch is unnecessary. These gear drives are made in sizes from 15 to 200 horsepower and may be furnished with either solid or hollow shafts.

Ball Valve Handles Light Slurries

211

Cooper Alloy Corporation, Hillside, N. J., has introduced its new ball valve designed to handle light slurries and to throttle for close regulation of flow.

Among the features of this new product are: a handle that has indications for throttling adjustment, and which has a positive-lock, snap-on design to eliminate tampering with settings; a stem that has an adjustable stuffing box that can be repaired under pressure, a positive slotted-drive keyway in the ball to eliminate ball wear, and "V" ring packing for leakage elimination.

Other features include the use of Teflon seals for more positive sealing, and union ends that provide automatic self-alignment with piping. These valves can be "on flow" in either direction, and their compactness provides ready installation in tight or hard to get at spots.

Acid Neutralizer for Solution Feeders

212

Calgon Company, Division of Hagan Chemical and Controls, Inc., are now offering an acid neutralizer, a highly soluble alkaline product for use with solution feeders to neutralize or raise the pH value of corrosive water.

Formulated to dissolve rapidly and form a sterile feed solution, this new compound helps stop blue or green staining frequently caused by the corrosion of copper plumbing. It does not crystallize out of solution during cold weather and is compounded to prevent precipitation of scale in feeding equipment.

For most installations, a starting dosage of 20 parts per million is recommended. Exact dosages can be determined by checking pH of treated water with the pH test papers included in each acid neutralizer drum. The proper feed rate is obtained when pH reaches 7.2.

Layne

ASSOCIATE COMPANIES

LAYNE-ARKANSAS COMPANY
Stuttgart, Arkansas

LAYNE-ATLANTIC COMPANY
Savannah, Georgia; Norfolk, Virginia; Glen Burnie, Maryland; Orlando, Florida; Albany, Georgia; Florence, South Carolina

LAYNE-CENTRAL COMPANY
Memphis, Tennessee; Pensacola, Florida; Jackson, Mississippi

GENERAL FILTER COMPANY
(Complete Water Treatment) Ames, Iowa

LAYNE-LOUISIANA COMPANY
Lake Charles, Louisiana

LAYNE-MINNESOTA COMPANY
Minneapolis, Minnesota

LAYNE-NEW YORK COMPANY
Linden, New Jersey; New Hyde Park, L. I., New York; Arlington, Massachusetts; Pittsburgh, Pennsylvania; Camden, New Jersey

LAYNE-NORTHERN COMPANY
Mishawaka, Indiana; Indianapolis, Indiana; Lansing, Michigan

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Milwaukee, Wisconsin

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LAYNE TEXAS COMPANY
Houston, Texas; Dallas, Texas; El Paso, Texas; Corpus Christi, Texas

LAYNE-WESTERN COMPANY
Kansas City, Missouri; St. Louis, Missouri; Aurora, Illinois; Ames, Iowa; Omaha, Nebraska; Wichita, Kansas; Denver, Colorado

INTERNATIONAL WATER SUPPLY, LTD.
London, Ont., Canada; Montreal, Quebec, Canada; Oakville, Ont., Canada; Vancouver, B. C., Canada; Saskatoon, Sask., Canada

INTERNATIONAL WATER CORPORATION
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LAYNE PACIFIC DIVISION
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COMPANIA ARGENTINA PRODUCTORA DE AGUA, S.R.L.
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L'HYDRAULIQUE-AFRIQUE—Paris, France; Algiers, Algeria; Dakar, French West Africa; Tunis, Tunisia; Cairo, Egypt

INDUSTRIAL SALES REPRESENTATIVES IN THESE PRINCIPAL CITIES:

Albuquerque, N.M.; Atlanta, Ga.; Boston, Mass.; Buffalo, N.Y.; Charleston, W.Va.; Charlotte, N.C.; Chicago, Ill; Cincinnati, Ohio; Coral Gables, Fla.; Detroit, Mich.; Grand Rapids, Mich.; Honolulu, Hawaii; Houston, Tex.; Indianapolis, Ind.; Jacksonville, Fla.; New York, N.Y.; Philadelphia, Pa.; Richmond, Va.; St. Paul, Minn.; St. Petersburg, Fla.; Salt Lake City, Utah; South Bend, Ind.

There's a world of service available
WHEN YOU SPECIFY LAYNE

There's a world of service available

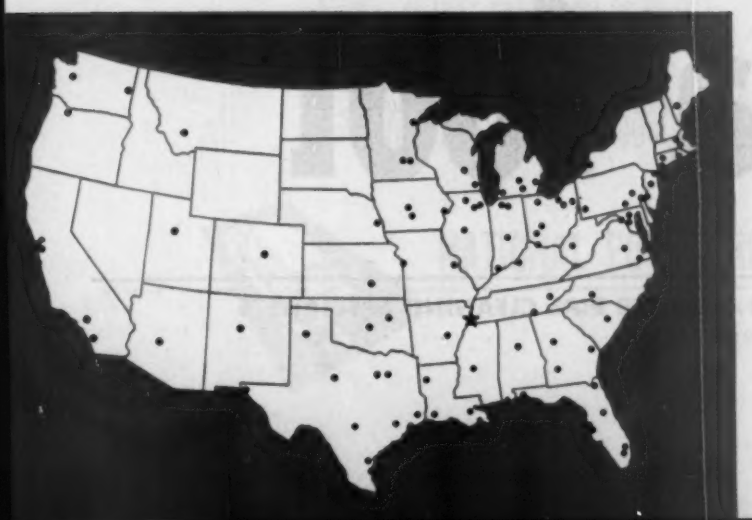
when you specify *LAYNE*

PUMPS • WATER WELLS • WATER TREATMENT

Any service is only as good as its availability when you need it.

Layne service for *any* pumps, wells, water systems and water treatment for Industry—Municipalities—Agriculture is available throughout the world, 24 hours a day. The vast network of Layne Associate Companies with over 75 years' experience, trained personnel and quality Layne replacement parts, assure prompt and complete service wherever you may be located. Industrial Sales Representatives in major cities. Write for Layne Service Bulletin 100.

Layne complete water services include: initial surveys • explorations • recommendations • site selection • foundation and soil sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment • all backed by Layne Research.



Layne SINCE 1902 — WORLD'S LARGEST WATER DEVELOPERS

LAYNE & BOWLER, INC., MEMPHIS

GENERAL OFFICES AND FACTORY, MEMPHIS 8, TENN.

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Sales Representatives in Major Cities

We're proud of our to clean water

THE FIRST

of your water or sewer mains cleaned for only

1¢ a foot

AMERICA'S LARGEST SEWER & WATER PIPE CLEANING SPECIALISTS

unmatched ability and sewer mains

100 FEET

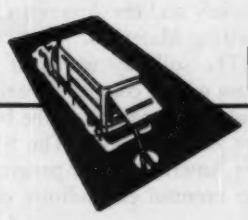
CALL COLLECT, WRITE, WIRE . . . We offer you the proof—the first 100 feet of your mains cleaned for only 1 cent per foot—Total: $1.00. If you are not completely satisfied per our ironclad guarantee below, you pay nothing.

ONLY N.P.R.C. CAN GIVE YOU AN

IRONCLAD GUARANTEE

If we can't unclog your clogged water mains or sewer systems—NOBODY CAN! Your job is fully guaranteed or there is no charge for our service.

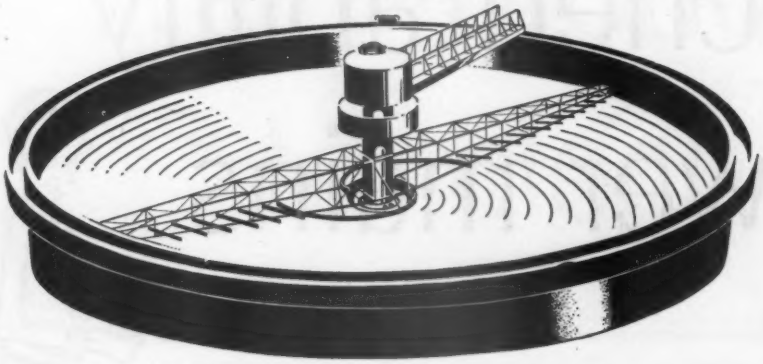
Harold Rudnick
President



NATIONAL POWER RODDING CORPORATION

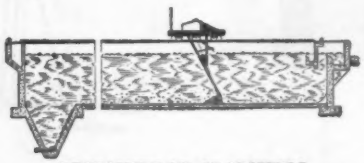
1000 SOUTH WESTERN AVENUE • CHICAGO 12, ILLINOIS
PHONE MOnroe 6-7700

WATER, SEWAGE AND TRADE-WASTE TREATING EQUIPMENT



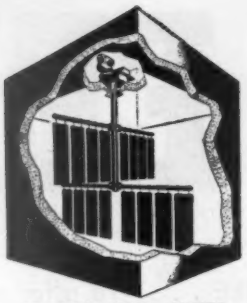
CIRCULAR CLARIFIERS

Hardinge Circular Clarifiers are available in sizes up to 200' diameter, either center-column or beam supported for steel, concrete, wood or tile tanks. Sludge scrapers remove settled solids rapidly through central underflow discharge.



RECTANGULAR CLARIFIERS

Especially suited for limited spaces or where sludge delivery is desired at one end of the tank. A traveling scraper and skimmer carriage removes settled solids from the tank bottom and scum from the top.

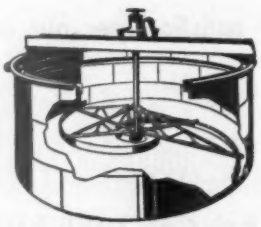


FLOCCULATING UNITS

Slowly rotating paddles on vertical shafts bring the small flocs into contact to form larger masses and hasten precipitation.

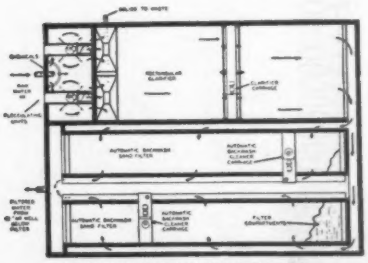
HYDRO-CLASSIFIERS

A large-volume classifier for rapid separation of coarse and fine suspended solids. Frequently used for by-product recovery from waste water.



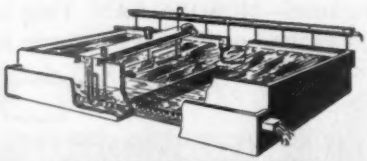
"AUTO-RAISE" THICKENERS

For removal of fine suspended solids from supply water, waste water and sewage. "Auto-Raise" mechanism prevents scraper breakage. Manual or power raise supplements "Auto-Raise." Replacement ring-type ball bearing support for rotating mechanism. Spiral rakes for maximum underflow density.



COMPLETE WATER SYSTEM

Hardinge also offers a complete water treating unit, combining flocculating equipment, clarifiers and filters in one, common-wall system, using modular construction.



AUTOMATIC BACKWASH FILTERS

For high removal of non-settling or slow settling suspended matter. Self-cleaning sand bed. No shut-down necessary for backwashing. Traveling backwash mechanism.

Write for Bulletin 35-D-15

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COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 ARCH ST. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco • Birmingham • Jacksonville Beach

News of Suppliers

Graver Names New General Manager

Graver Water Conditioning Co., Division of Union Tank Car Co., New York, N.Y., has announced the naming of Marvin Lane, technical director of the Division, to the post of general manager. He succeeds H. T. Sulcer who recently resigned.

"This appointment," stated a company spokesman, "reflects the intent of Union Tank Car to emphasize research and development of new and better products." Graver Water designs and manufactures products and systems for industrial and municipal water treatment, industrial waste treatment, boiler feedwater treatment and chemical processing.

As technical director, Mr. Lane headed a Graver Water research and development program that resulted in the development of such new items as, the first dialysis liquid purification system for acids, monitoring controls for automatic treatment plants, purification equipment for power plant condensate, non-corrosive underdrains for gravity filters, and subfill-less underdrains for ion exchange units.

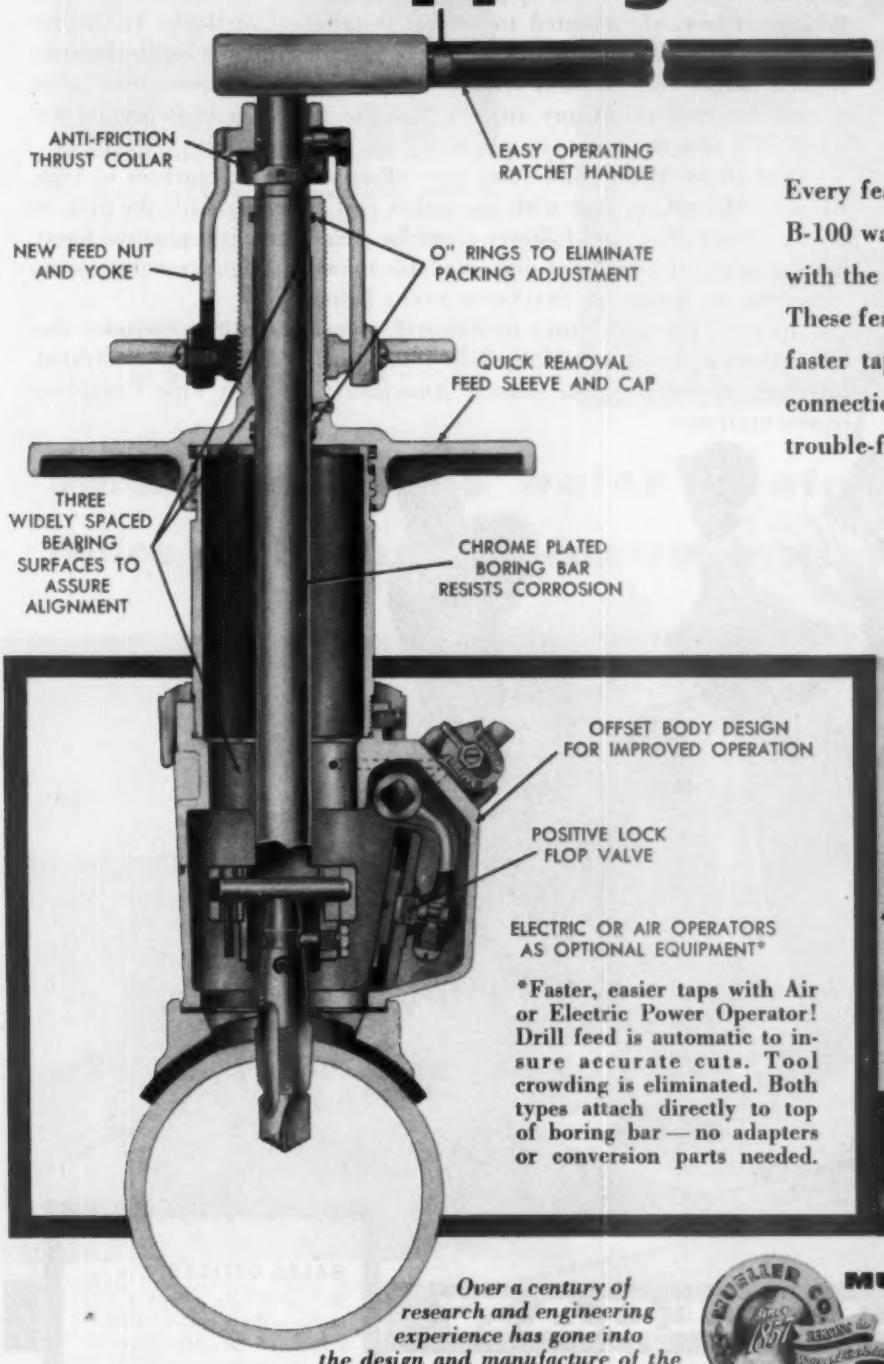
Prior to joining Graver Water in 1949, Mr. Lane was instrumental in developing synthetic U.S.P. quality water through silica removal by ion exchange and conducted the first field tests on commercial equipment for this purpose. Among the professional societies to which he belongs are the American Chemical Society and the American Society for Testing Materials.

The spillway works at Ice House Dam will be completed early this year, and other projects of the big program are already begun. The SMUD Upper American River program involves the eventful expenditure of $85,000,-

CONTINUED ON PAGE 102A

operators like the ease . . .
the speed . . . the accuracy of the new

MUELLER® B-100 tapping machine!


ANTI-FRICTION THRUST COLLAR
EASY OPERATING RATCHET HANDLE
NEW FEED NUT AND YOKE
O" RINGS TO ELIMINATE PACKING ADJUSTMENT
QUICK REMOVAL FEED SLEEVE AND CAP
THREE WIDELY SPACED BEARING SURFACES TO ASSURE ALIGNMENT
CHROME PLATED BORING BAR RESISTS CORROSION
OFFSET BODY DESIGN FOR IMPROVED OPERATION
POSITIVE LOCK FLOP VALVE
ELECTRIC OR AIR OPERATORS AS OPTIONAL EQUIPMENT*

Every feature of the new B-100 was designed with the operator in mind. These features give you faster taps, pressure-tight connections and easy, trouble-free operation.

*Faster, easier taps with Air or Electric Power Operator! Drill feed is automatic to insure accurate cuts. Tool crowding is eliminated. Both types attach directly to top of boring bar — no adapters or conversion parts needed.

Over a century of research and engineering experience has gone into the design and manufacture of the B-100 Drilling, Tapping and Inserting Machine.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario.

Drop your pipe problem OVERBOARD

...with AMERICAN Molox Ball Joint Pipe!

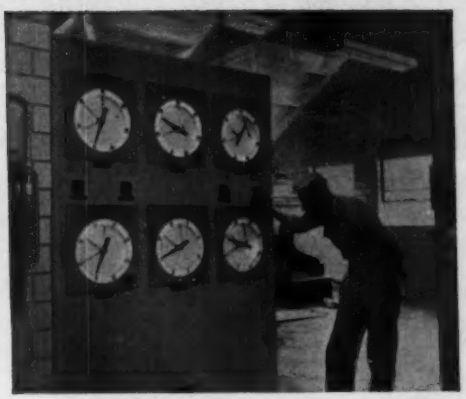
Specify AMERICAN Molox Ball Joint Pipe for river crossings and other difficult installations. Molox pipe affords maximum installation economies because it is easily adapted to several installation methods: It can be floated or pulled across streams, or can be installed directly on the bottom from a barge. Once laid, it remains bottle-tight under pressures up to several hundred psi at any angle within the 15° range of deflection for which it is designed.

AMERICAN Molox Ball Joint pipe offers all the advantages of high strength Mono-Cast pipe with the socket cast *integrally* with the pipe; a heavy section alloy steel follower gland for added strength; plus the finest bolting of any flexible joint pipe available today . . . high strength, corrosion-resistant AMERICAN STAINLESS STEEL bolts.

Before "plunging" into underwater pipe installations consider the advantages of AMERICAN Molox Ball Joint Pipe. Write for free illustrated brochure or contact your nearest American Cast Iron Pipe Company representative.

AMERICAN
CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

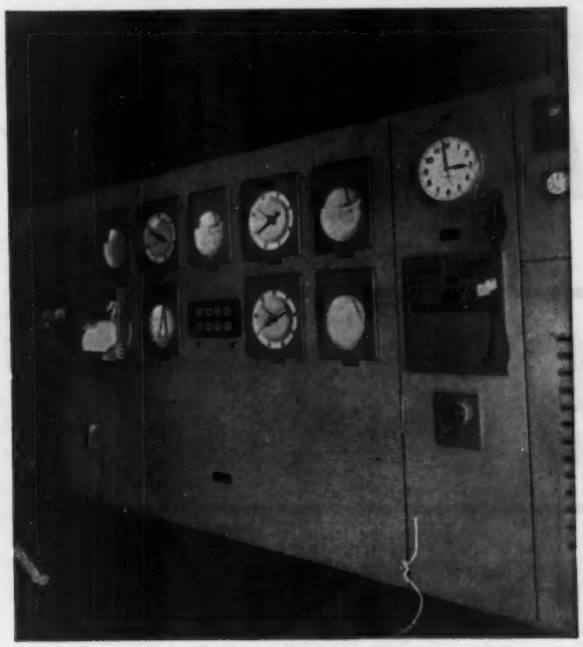
SALES OFFICES: Chicago
New York City—Kansas City
Dallas—Minneapolis—Denver
Pittsburgh-Orlando-Cleveland
Birmingham



This chemical building panel provides plant operators with records of key flow variables. Basin and bypass flows are indicated, recorded, and integrated.

Honeywell *Filtermatic* consoles control all filter valves. Each of eight consoles can control filtering of 8 m.g.p.d., but presently monitors about 2 m.g.p.d.

Springfield, Ohio water treatment plant relies on Honeywell control instrumentation



Master filter building control panel provides centralized information on key flows, pressures, and levels. Also features central alarm and communication system.

The recently built $5,800,000 water treatment plant at Springfield, Ohio, is a model of efficient, low-cost operation. Treatment variables are measured and/or automatically controlled by a Honeywell system. Black & Veatch, Kansas City, were the consulting engineers, and G. E. Tillman Co., Centralia, Ill., the contractor.

Modern instrumentation techniques were exploited to the fullest in specifying controls for this plant. For example, raw water influent is measured at two separate points, totalized, and telemetered to both the filter building master control panel and the chemical building panel.

Fully pneumatic operators on the filter valves enable effluent to be adjusted either locally or remotely—manually, or automatically from changes in clear well level. This results in optimum flexibility and centralization.

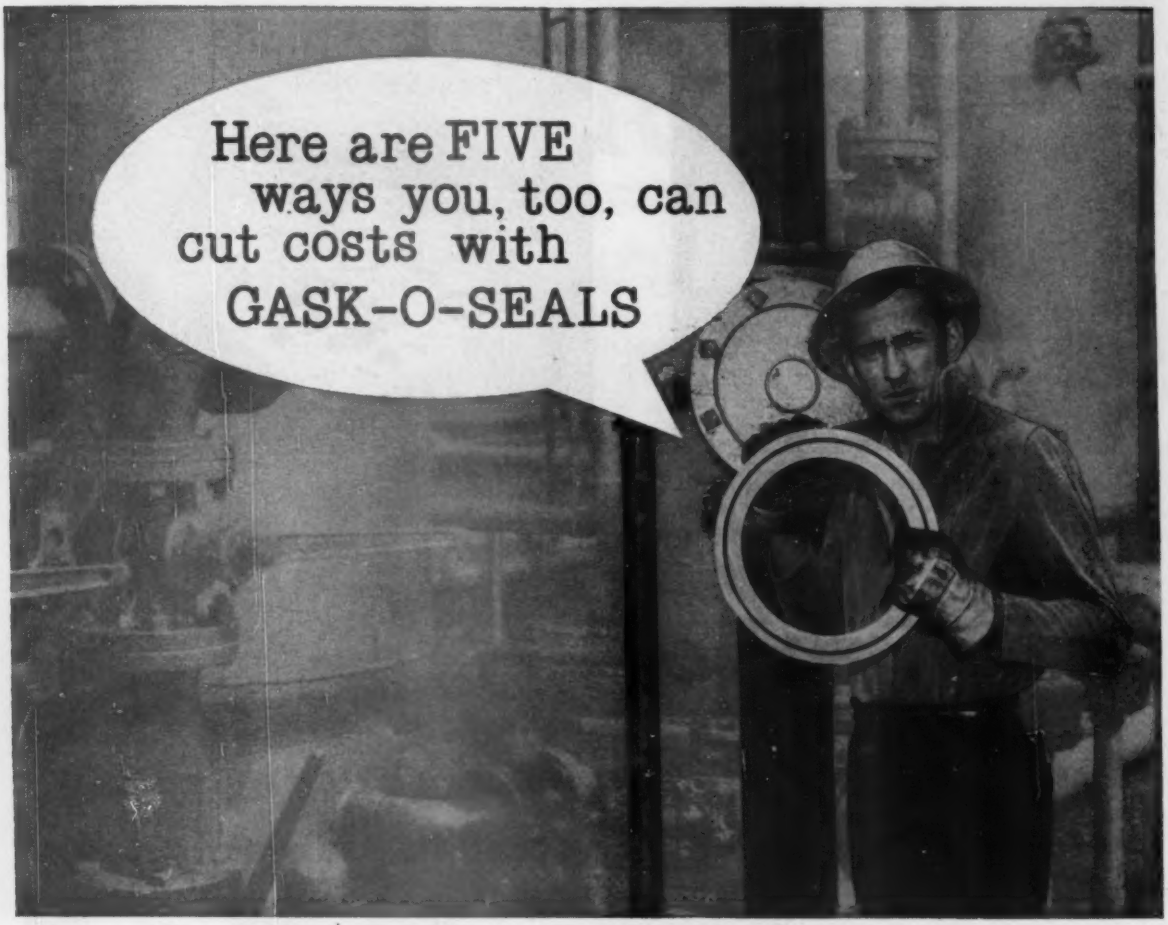
Honeywell controls make every phase of the treatment process a dependably precise, automatic operation at the Springfield plant. For help in applying the latest, up-to-date automatic control to your own water treatment project, contact your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Control

SINCE 1885



1

No scraping, cleaning, resurfacing or replacing flanges when installing new seal!—

The unique design of Gask-O-Seals will save hundreds of man hours, and eliminate the tedious work of reconditioning flanges.

2

Save downtime—

Gask-O-Seals will not wear due to **pulse** or **vibration**. They last longer and are quickly and easily changed. **Sure, positive** sealing extends seal life. Fool proof installation reduces replacement time and repair.

3

Eliminate extreme hazard of "blow-out"—

Since Gask-O-Seals are **totally** confined with metal-to-metal contact of faying surfaces, the danger of a seal "blowing out" is completely eliminated under normal working conditions. This feature alone can save your company millions of dollars.

4

No retorquing of bolts necessary—

Once a Gask-O-Seal is installed there is no need to re-torque bolts. The seal can not "creep" or "cold flow." There is no need for tightening bolts to maximum, causing distortion of flanges. ..... the flanges are easy to break loose at time of repair or overhaul.

5

Re-useable—

Due to the carefully controlled mass-to-void ratio in the Gask-O-Seal design, the seal can not be over squeezed — its "memory" never destroyed by fastening pressures. They, therefore, may be reused several times with just ordinary care.

Plus — Due to low fastening torques required to effect a seal, flanges can be designed to greatly reduce mass and smaller bolts used, less bulky wrenches and tools are required and automatic equipment used for even faster installation. Gask-O-Seals will seal water, oil, air, hydraulic fluids, gases, gasoline and many other fluids; hi-vacuum to hi-pressure, in a very wide temperature range.

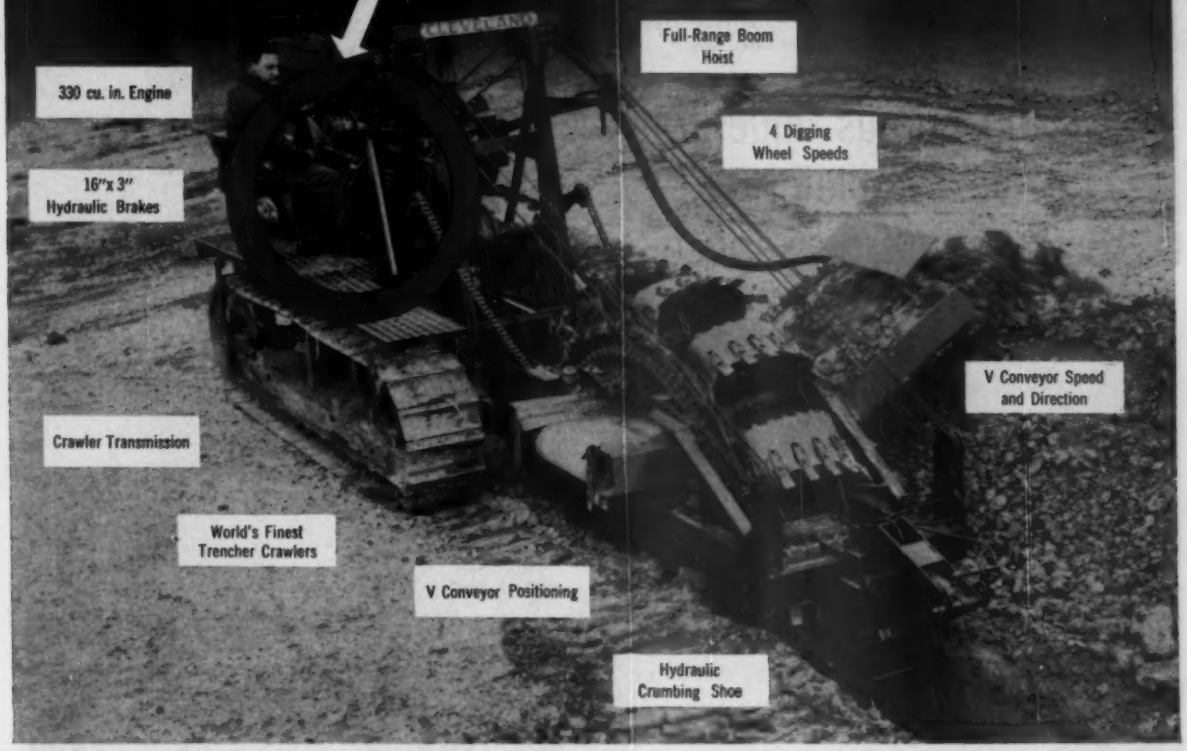
Try Gask-O-Seals and reduce your maintenance costs **now.**

Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO

A DIVISION OF PARKER-HANNIFIN CORPORATION

100% CONTROL OF EVERY OPERATION IS HERE IN CLEVELAND TRENCHERS



WHEEL SPEEDS: big engine develops 50 HP at only 1250 RPM, drives through main transmission to digging wheel differential; operator has choice of 4 forward wheel speeds, 1¼ to 8 RPM, plus reverse.

CRAWLER TRANSMISSION: this famous Cleveland-exclusive feature provides 12 individual crawler speeds for *each* of 4 wheel speeds, allows operator to choose, from over 30 *usable* combinations of wheel and crawler speeds, the *right* combination of power and speed for every digging condition.

HYDRAULIC STEERING: big 16" x 3" internal hydraulic brakes, controlled by suspended-type foot pedals, provide easy steering and maneuvering of the...

WORLD'S FINEST TRENCHER CRAWLERS: a tremendously long-lived, stable, trouble-free, easy rolling track; 1000-hour lubricated, it employs double-flanged wheels rollers and sprockets with teeth widely spaced, drives on each end of 1½-inch hardened crawler pins.

BOOM HOIST: two easy-acting levers independently control raising and lowering each end of digging wheel boom through full height and depth range.

V CONVEYOR SPEED AND DIRECTION: dual, independent, pulley-enclosed hydraulic drives give operator instant control of conveyor belt speed and direction of discharge, eliminate need of conveyor chains, sprockets, hung-on motors, etc.

V CONVEYOR POSITIONING: operator shifts conveyor hydraulically from side to side, placing spoil wherever desired while digging past trees, poles, etc.

HYDRAULIC CRUMBING SHOE: operator controls raising and lowering of shoe, as required, for lifting or setting digging wheel at walks, driveways, underground obstructions, etc.—an exclusive Cleveland feature which makes crumbing practical even in obstruction-crowded digging.

Get the complete story on Cleveland J Trenchers from your distributor

Good Everywhere

The CLEVELAND TRENCHER Co.

20100 St. Clair Avenue • Cleveland 17, Ohio

WILLIAM KERIVAN, Chief Filter Plant Operator, Billerica (Mass.) Water Treatment Plant, says:

"Our porous underdrains give completely trouble-free service..."

Mrs. Barbara E. Hawkes, Chief Chemist, checks backwashing of Billerica's #1 filter.

The Billerica Water Treatment Plant serves 26 square miles, supplying 1.0 MGD from the Concord River. Beds for Billerica's four filters are 30" of sand and 18" of anthracite, with ALOXITE® aluminum oxide porous bottoms. Average load is 1.5 MGD and 2.0 MGD during peak periods.

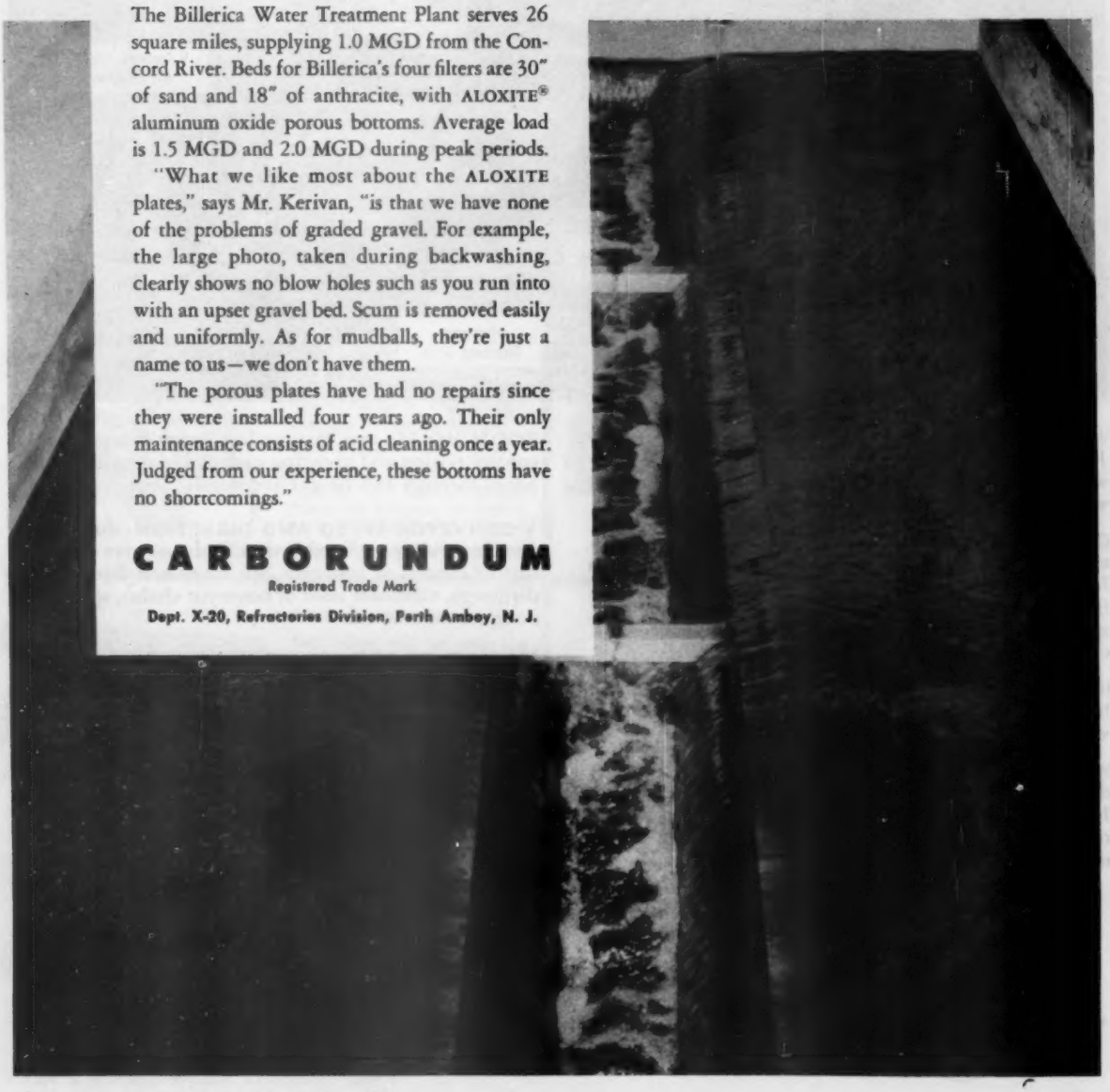
"What we like most about the ALOXITE plates," says Mr. Kerivan, "is that we have none of the problems of graded gravel. For example, the large photo, taken during backwashing, clearly shows no blow holes such as you run into with an upset gravel bed. Scum is removed easily and uniformly. As for mudballs, they're just a name to us—we don't have them.

"The porous plates have had no repairs since they were installed four years ago. Their only maintenance consists of acid cleaning once a year. Judged from our experience, these bottoms have no shortcomings."

CARBORUNDUM

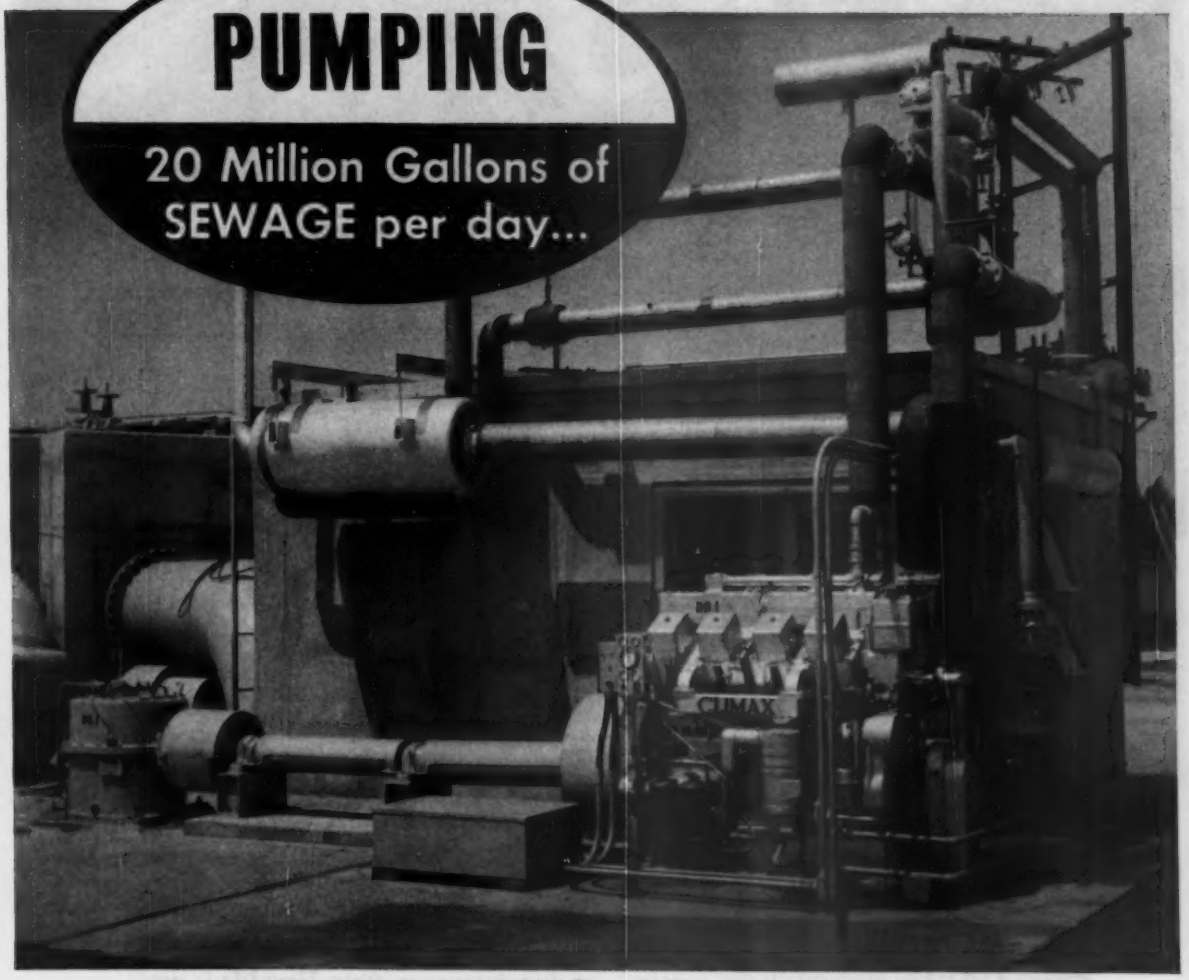
Registered Trade Mark

Dept. X-20, Refractories Division, Perth Amboy, N. J.



PUMPING

20 Million Gallons of SEWAGE per day...



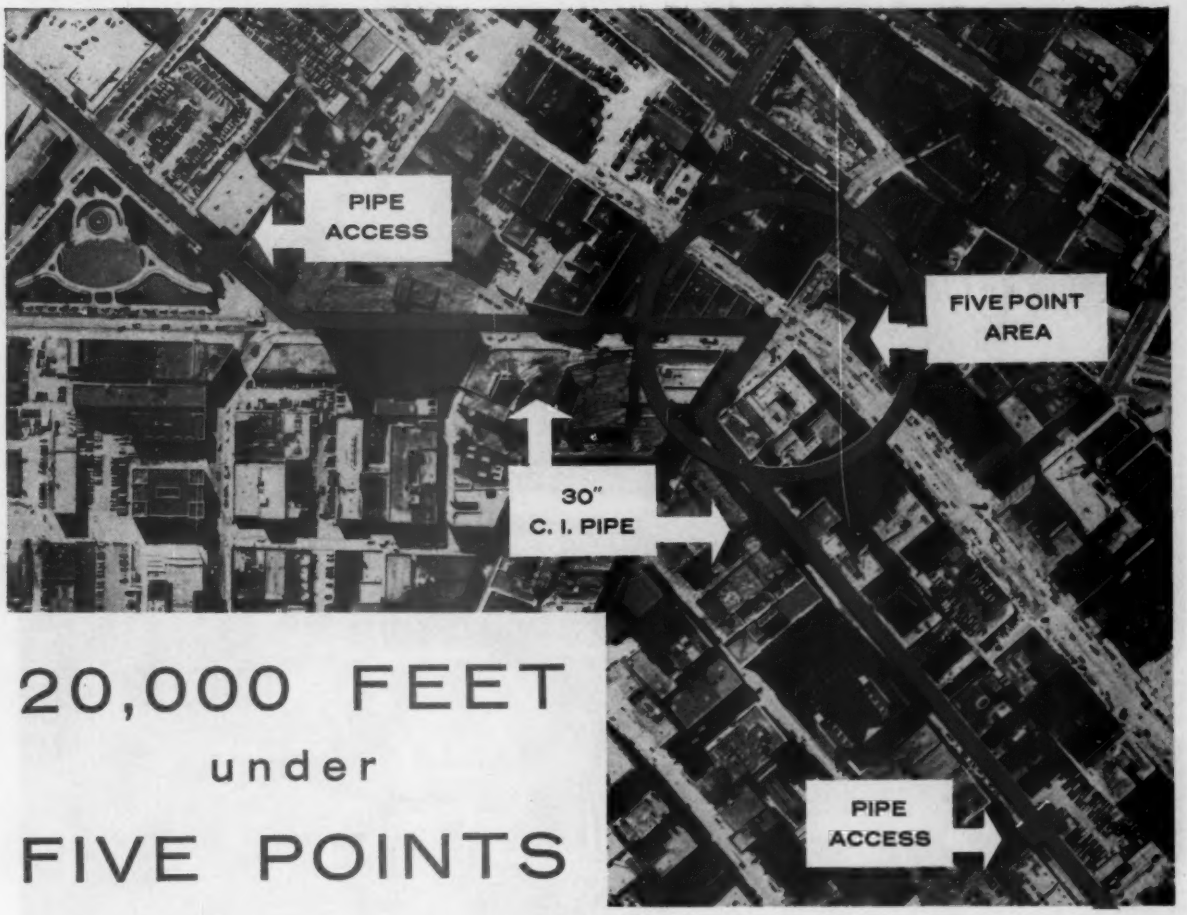
at Orange County, California, Sanitation District

two CLIMAX V-85 ENGINES *power the pumps*

Driving centrifugal pumps, two Climax V-85 Engines running at 775 rpm, pump approximately 20 million gallons of sewage per day in Plant No. 1 of the County Sanitation Districts of Orange County, Calif., at Ellis and Verano Streets, Santa Ana. These V-85 Climax Engines —8-cyl., 7½-in. bore x 7-in. stroke, 2474 cu. in. displacement—are burning sludge gas from the digesters; when this gas is not available the engines are automatically switched over to butane fuel. They operate with vapor phase cooling, and the waste heat is used in the digesters. The Climax V-8, unusually compact in design, packs more power into less space. Rugged, too, for durability with dependability in continuous duty sewage plant service. Its famous fuel economy is built-in. For all its plus-value features in detail, get Bulletin SA-584.

CL-109

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA



20,000 FEET under FIVE POINTS

You're flying over "Five Points," Atlanta's booming downtown area. Through the heart of this busy section Centriline crews have recently reconditioned almost 20,000 feet of water mains *—without slowing business or traffic.* No detours, no disgruntled merchants, and only two small access excavations in over 2,000 feet of dense traffic area, because the job was done with mains in place.

Centrilining—the process of lining pipes in place by the centrifugal application and automatic troweling of cement-mortar—offers other features, too. Gone forever are corrosion and tuberculation. Up goes pressure, at lowered pumping and maintenance costs. Pipe life is prolonged indefinitely. And all at a mere fraction of the cost and municipal inconvenience of laying new mains.

To date, Centriline has completed six contracts for the city of Atlanta alone; 150,000 feet of pipe have been given a new lease on life. Send today for our illustrated brochure, which shows in detail how the Centriline process can help you save lines from 4 to 144 inches, or contact any of our domestic offices.

CENTRILINE CORPORATION

A Subsidiary of Raymond International Inc.

140 CEDAR STREET • NEW YORK 6, N. Y.

Branch offices in principal cities of the United States, Canada, and Latin America.

MODERN AS TOMORROW

Plant Superintendent: Harold W. Augenstein
Consulting Engineers: Consoer, Townsend & Associates, Chicago

Primary tanks with Rex Conveyor Sludge Collectors and Roto-Skim Pipes.

Final tanks with Rex Unitube Tow-Bro Sludge Removers.

HAMILTON, OHIO, PLANT

Planned For Peak Performance

The Hamilton, Ohio, new split activated sludge sewage treatment plant is a tribute to sound planning that considered not only today's but tomorrow's requirements. In anticipation of a substantial population and industrial expansion, the planning team designed a plant that would provide maximum efficiency with adequate reserve capacity for future growth of the community.

The new plant has a designed average flow of 12 m.g.d., with a maximum designed flow of 18 m.g.d. handling both municipal and industrial wastes. In the design of the Hamilton plant, maximum utilization of available area was accomplished through a compact arrangement of the treatment units by using common wall construction throughout.

The grit chambers, equipped with Rex Chain and Bucket Grit Collectors, and the rectangular primary tanks, with Rex Conveyor Sludge Collectors and Roto-Skim Pipes, are neatly grouped with the rectangular aeration tanks and the three square final tanks. Future expansion of these units with a minimum of cost is guaranteed.

In the final tanks, Rex Unitube Tow-Bro Sludge Removers assure maximum flexibility in operation ... both today and for years to come. With more positive and general removal of sludge, the Tow-Bro provides ample facilities for efficient operation under varied conditions.

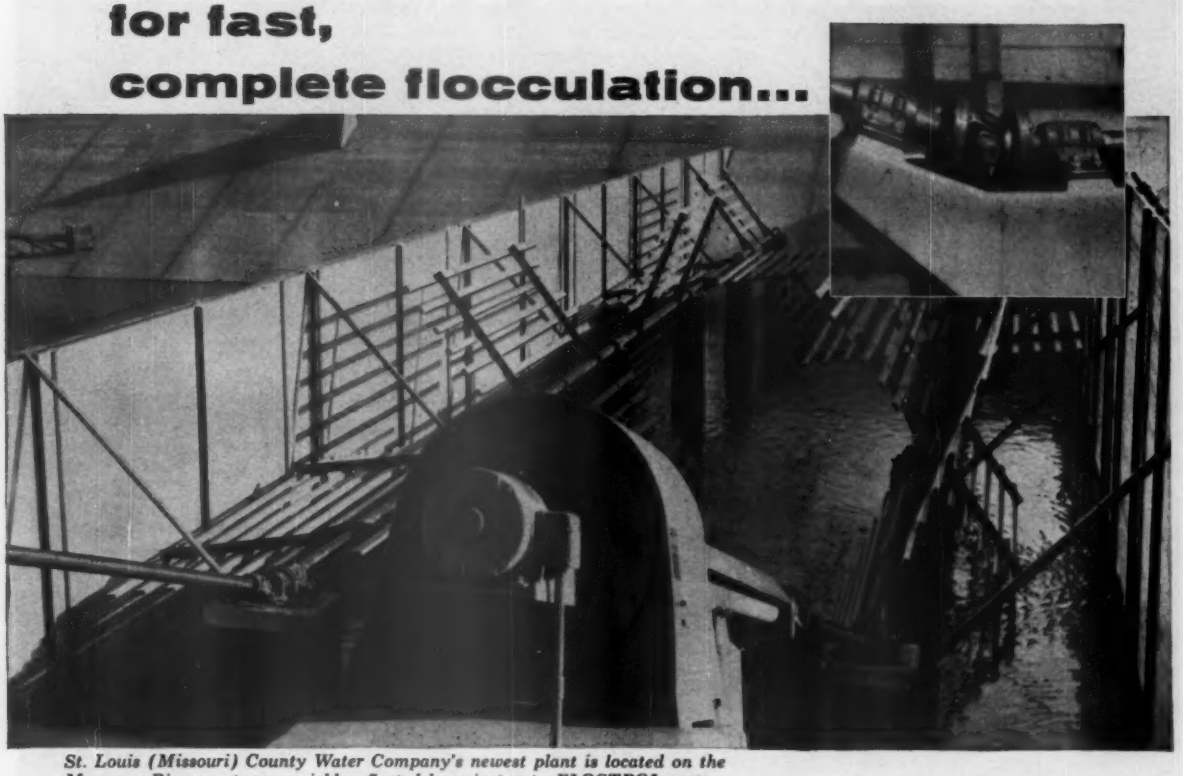
Rex Waste Treatment Engineers are available to help design and select equipment for modern plant performance as at the Hamilton, Ohio, plant. For complete information, write CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

REX®

CHAIN BELT COMPANY

Specialized Equipment for the Effective Treatment of Water, Municipal and Industrial Wastes.

FLOCTROL®
for fast, complete flocculation...



St. Louis (Missouri) County Water Company's newest plant is located on the Meramac River, a stream quickly affected by rainstorms, FLOCTROL system provides fast, thorough, lower-cost clarification in this efficient 15 mgd. plant.

minimum chemical dosage, 30% smaller basins

Jeffrey FLOCTROL systems clarify water, sewage and industrial wastes efficiently and at lower cost:

PROVEN DESIGN—Decreasing rates of agitation and increasing time periods as flocculation progresses insure fast, thorough diffusion of chemicals and complete coagulation.

SINGLE MECHANISM—Rapid and slow mixing are both done with one mechanism, reducing initial and operating costs.

EASY ADJUSTMENT—Rates of agitation are adjusted simply by changing number and arrangement of paddle blades or speed of rotation.

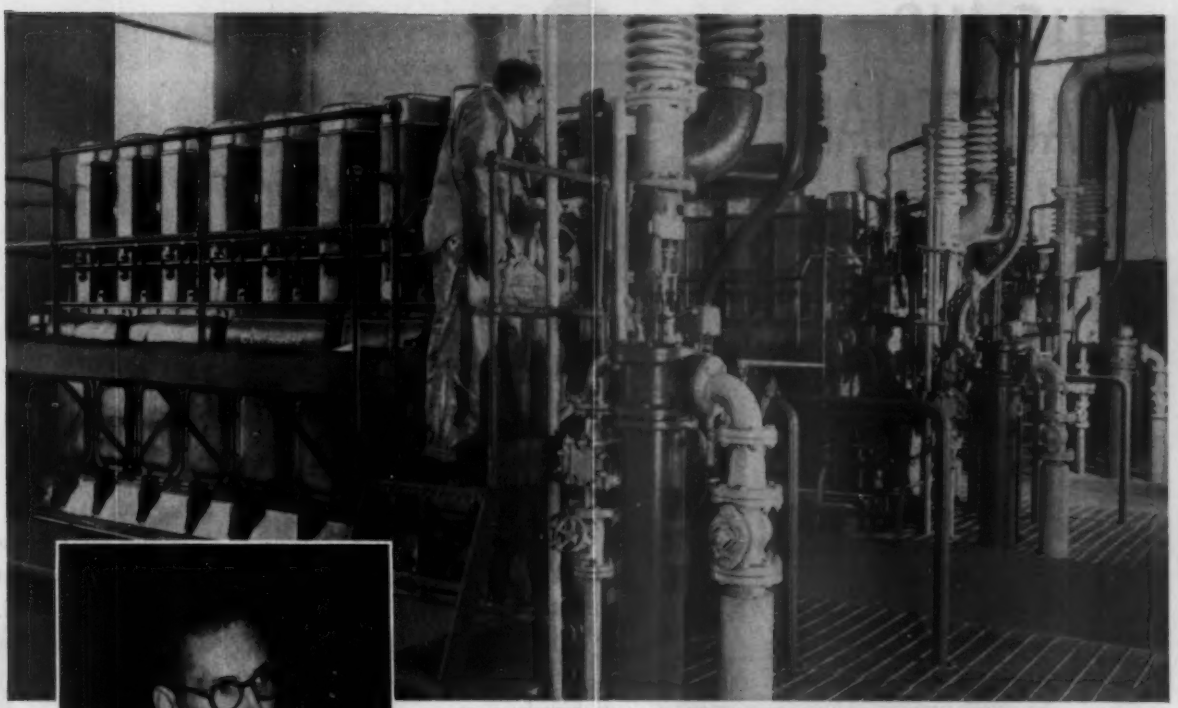
SMALLER BASINS—30% smaller flocculation basins made possible by stationary and rotating baffles, which allow minimum short-circuiting. Settling basin capacities reduced 30% by quicker settling floc.

Jeffrey FLOCTROLS are available in standard horizontal type . . . special horizontal type for use where rapid mixing takes place in a separate basin . . . vertical type for smaller locations where indicated. Catalog 905 describes these and other Jeffrey equipment for water, sewage and industrial waste treatment. The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...
TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

Enterprise Engines Run 90% on Free Sewage Gas



Three 625 HP Enterprise Dual Fuel engines at San Jose, Calif. handle the complete power load for all electrical and pumping requirements of this sewage plant.

"Trouble-free and maintenance-free, with very reasonable manpower requirements."

Frank M. Belick

Supt., San Jose, Calif., Sewage Treatment Plant

"We're extremely pleased with the record of efficiency and economy experienced to date with our three Enterprise Engines. They have operated trouble-free and maintenance-free, fitting in exceptionally well with our treatment plant requirements.

"By operating on methane, the sludge gas by-product of sewage treatment, our fuel costs have remained at a minimum. In addition, the Enterprise Dual Fuel 'Select-O-Matic'® feature has given us the flexibility we need when sludge gas production becomes erratic. On either gas or oil the engines respond well to changes in power demands. All in all, these engines provide us the dependable, continuous operation we need with very reasonable manpower requirements."

This and other model sewage plants in such cities as New York; East Boston, Mass.; San Diego, Calif.; Toledo, Ohio; Springfield, Ohio; Durham, N.C.; and Sioux Falls, S.D., attest to the fact that complete dependability and economy of municipal operations start with Enterprise Engines.

Enterprise specializes in engines for stationary and portable electric power generation, flood and water pumping systems, and sewage plant power. Versatile fueling is available in diesel, dual fuel and spark ignited gas engines. Models range from 73 to 7703 HP. Call in the Enterprise sales engineer in your area, or contact factory direct for information or help with your plans.

ENTERPRISE
dependable **ENGINES**

Over a million horsepower at work the world over!

ENTERPRISE ENGINE & MACHINERY CO.
Subsidiary of General Metals Corporation
18th and Florida Streets, San Francisco 10, California
Export Department, San Francisco

Boston • Chicago • Des Moines • Fort Worth • Huntington • Jacksonville • Kansas City • Los Angeles
New Orleans • New York • Pittsburgh • San Diego • Seattle • St. Louis • Washington, D.C.

DeZurik..... THE "NO MAINTENANCE" VALVE

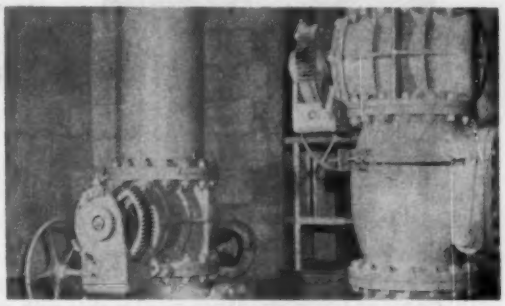
FOR WATER TREATMENT PLANTS

EASY OPERATION

DeZurik Valves' unique Eccentric Principle guarantees easy operation every time! The plug comes in contact with the valve body ONLY when the valve is closed. Opening the valve backs the plug away from the seat and the valve opens easily—without friction, without sticking!

NO LEAKAGE

The resilient facing on a DeZurik plug closes dead-tight without extra pressure, despite grit, sand or silt. The cushioned closure seals *around* solids that may lodge on the seat, assuring positive leak-free operation everytime—on *any* filtration plant service.



NO LUBRICATION

DeZurik Valves need no lubrication to operate easily and close tight. Their eccentric action assures smooth easy operation . . . their resilient plug facing guarantees tight shut off . . . without lubrication! No greases or guns to stock, no lube schedule to maintain, no need for a "valve-greaser!"

For more information on DeZurik Valves, contact the DeZurik representative near you or write for details.

DeZurik Valves can serve you better on so many water plant lines: raw water inlet, sand filter intake, discharge and backwash, wash water to filters and drains and others.

DeZURIK CORPORATION
SARTELL, MINNESOTA

the reason more and more water systems standardize on **MUELLER®** *gate valves:*

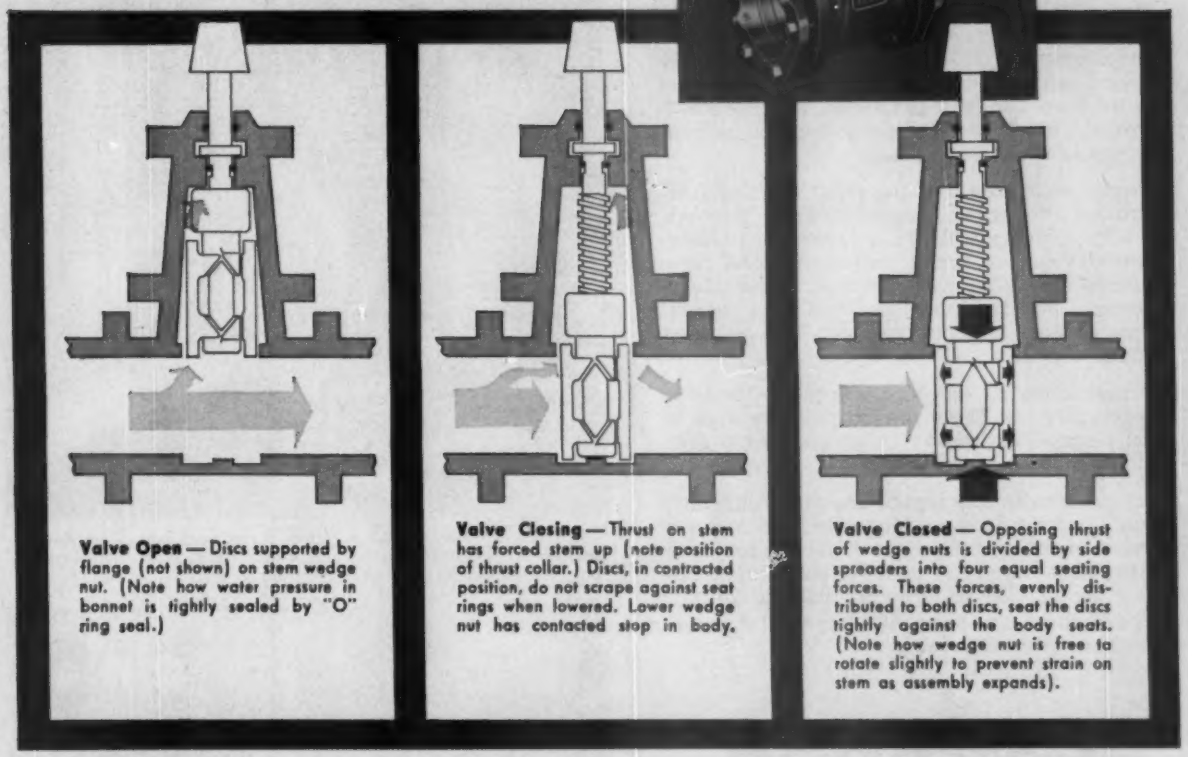
TIGHTER SHUT-OFFS TROUBLE-FREE OPERATION MINIMUM MAINTENANCE

... These are just a few of the benefits you get from installing Mueller double-disc, parallel-seat valves with exclusive "4-Point wedging mechanism design.

The drawings below illustrate the principle. Torque applied to the valve stem is resolved into a vertical wedging force by the upper and lower wedge nuts. Side-spreaders transfer this force into a horizontal action and apply the force at four points on each gate disc.

Uniform seating loads are developed, eliminating disc distortion and deflection. Tighter, positive shut-offs are assured.

Here's how the "4-Point" mechanism works.



Valve Open — Discs supported by flange (not shown) on stem wedge nut. (Note how water pressure in bonnet is tightly sealed by "O" ring seal.)

Valve Closing — Thrust on stem has forced stem up (note position of thrust collar.) Discs, in contracted position, do not scrape against seat rings when lowered. Lower wedge nut has contacted stop in body.

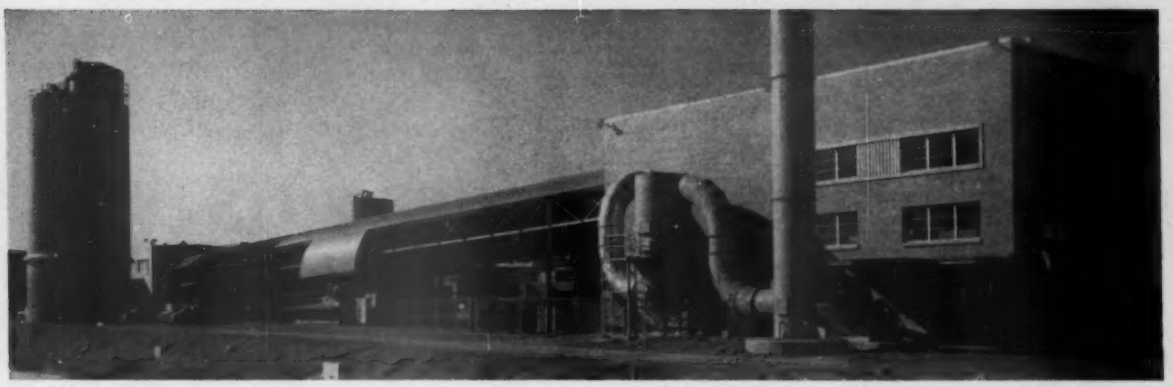
Valve Closed — Opposing thrust of wedge nuts is divided by side spreaders into four equal seating forces. These forces, evenly distributed to both discs, seat the discs tightly against the body seats. (Note how wedge nut is free to rotate slightly to prevent strain on stem as assembly expands).

Other bonus features — "O" ring stem seals *above and below* thrust collar... life-time lubricant completely surrounding thrust collar and sealed in by "O" rings... high tensile bronze stems with strong, electrically upset-forged thrust collar... sizes over 18" have extremely high-strength, cast manganese-bronze stems... complete line of end connections... full range of sizes.

Write for complete information and specifications.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario



Up to 150 tons of lime a day can be recovered by Dayton's Lime Recalcining Plant. City expects to get its $1,330,000 plant investment back in 20 years — plus a surplus estimated in the millions. *Consulting Engineers: Black & Associates, Gainesville, Florida.*

at City of Dayton –

self-amortizing lime recovery plant designed around Magnetic Flow Meters

Dayton, Ohio's million dollar lime recalcining plant would warm the cockles of the thriftiest Scotsman's heart. Designed to recover lime used in softening city water, the plant actually recovers up to 20% more lime than originally added, with additional capacity to process most of the lime sludge accumulated over the last 5 years! City plans to sell the overage — recover its investment in short order.

Dayton's Lime Recalcining Plant was designed around Foxboro Magnetic Flow Meters. Sludge, which would foul-up conventional head-loss devices, is easily measured since these unique meters have no flow restrictions. Measurement is instantaneous—continuous—linear. Rate of flow to centrifuges can be controlled exactly.

Maintenance on the Magnetic Flow Meter is practically nil. There are no pressure taps to get plugged or frozen . . . no seals or purges . . . no moving parts to foul.

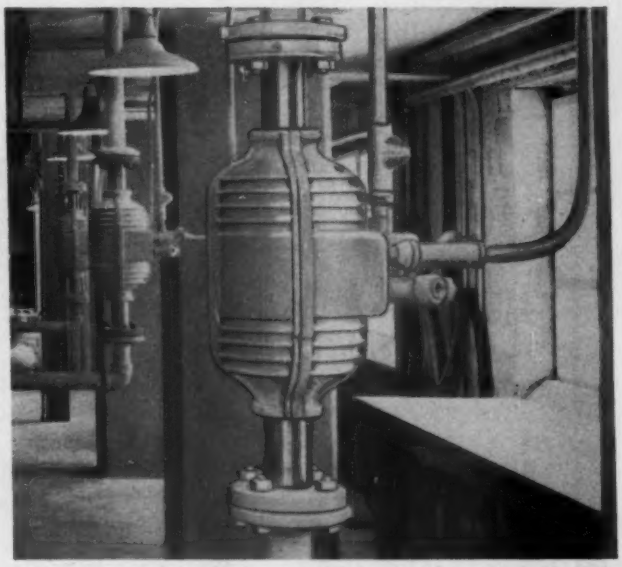
For practically any liquid, however "difficult", you'll find the Foxboro Magnetic Flow Meter a sound investment. Find out about this fabulous instrument today. Ask your Foxboro Field Engineer for details, or write for Bulletin 20-14C.

The Foxboro Company, 892 Neponset Avenue, Foxboro, Massachusetts.

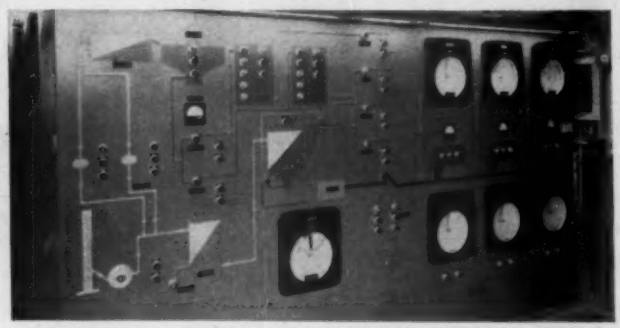
FOXBORO

REG. U.S. PAT. OFF.

MAGNETIC FLOW METERS



Three Foxboro Magnetic Flow Meters record and control the flow of sludge to centrifuges at Dayton's Lime Recalcining Plant. Meters cannot plug up because they have no flow restrictions.



"Graphic control panel in Feed End Building is helpful in breaking in new operators and in explaining the operation to visitors," reports Plant Supt. Robert C. Stout.

ARLINGTON, TEXAS, SOLVES "NUMBER ONE PROBLEM IN SEWAGE TREATMENT" WITH...

... COILFILTER

NO. 5 OF A SERIES ON FRESH SOLIDS DEWATERING

"Great strides have been made in the sludge dewatering operation. Wet sludge cake (3350 tons) with an average moisture content of 74.4% resulting in 838 tons of dry solids, was processed at an average cost of $12.78 per ton" . . . "From the information gathered at this installation, it would seem that the utilization of vacuum filtration for the treatment of raw sludge has proven to be a very satisfactory solution to the number one problem in sewage treatment." So states Arlington, Texas, sewage treatment plant Superintendent Irvin H. Nelson in his Annual Report for the operating year ending June 1, 1959. The report goes on to say "The sludge dumping area has not been a problem. The dewatered sludge, although exposed to the elements, will not re-absorb the moisture lost in dewatering."

This sewage treatment plant, designed by Reaves & Gregory for the City of Arlington, dewaters fresh solids on a 250 square foot Coilfilter. Sewage from a contributing population of 43,000 is treated.

Arlington is but one of many municipalities, with population as low as 3500, successfully dewatering fresh solids with Coilfilters.

Investigate Coilfilters, the only proved, positive method of fresh solids dewatering. Write for more information.

KOMLINE-SANDERSON ENGINEERING CORPORATION
PEAPACK, NEW JERSEY
BRAMPTON, ONTARIO, CANADA

MANUFACTURER OF COILFILTER SLUDGE VACUUM FILTERS AND AUXILIARY EQUIPMENT FOR DEPENDABLE FRESH SOLIDS DEWATERING

FINANCIAL PROTECTION

for your most vital service

Water . . . your community's most important single service . . . must be protected by sound financing. The only *sure* protection is the sustained accuracy of your water meters.

If a meter becomes inaccurate, it starts to give away revenue. In home after home, leaks and carelessness go scot-free. The warning voice of the meter is gradually stilled, and wanton waste soon uses up your available water supply.

Worse yet, lack of proper income makes it impossible to build new capacity without tremendous losses. Water shortages soon become critical. Your city's development program soon dies . . . of thirst.

How guard against this? Set up a good meter testing and repair program. Pick meters that stay accurate longer. Talk to your meter superintendent . . . the man whose efforts guard your water supply. Ask which brand of meter consistently gives highest sustained revenue . . . with lowest repair and depreciation. We sincerely believe your answer will be "Trident."

NEPTUNE METER COMPANY 19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD. 1430 Lakeshore Rd. • Toronto 14, Ont.

Branch Offices in Principal American and Canadian Cities.

neptune

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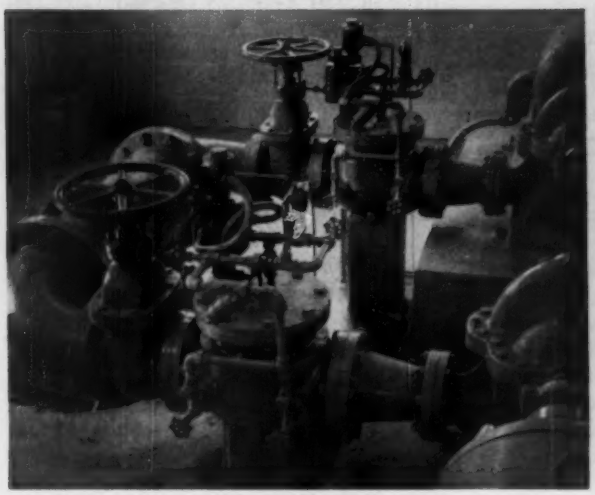
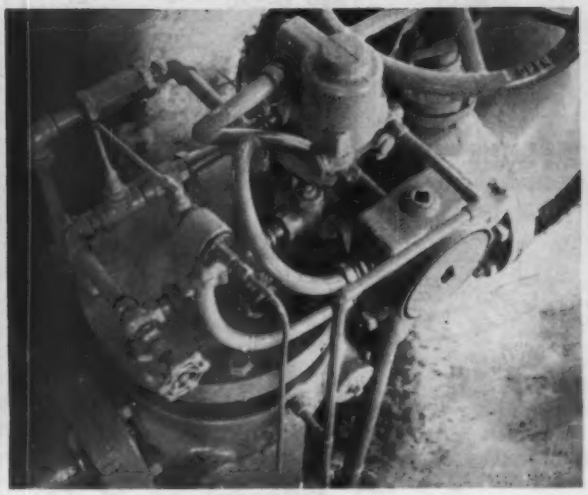
A Scranton Gillette Publication

WATER & SEWAGE WORKS





PUMP and VALVE installation (left) and valve close-up (right) are of . . .

Hydraulic-Powered Valves

by CLARK W. McKEE,
Pittsburgh Controls, Inc., Pgh., Pa.

RESUME: Manhandling large valves open or in closing is a hard slow job. For example, a 24 inch gate valve on a 100 psi line has a total force of 45,200 lbs on its disc. To open or close this valve manually requires some 150 turns on a large hand wheel.

Simple hydraulic pilot systems employing the differential-piston principle can accomplish the same job through fingertip control. The pilot system utilizes the line pressure to perform the work in opening or closing valves.

■A DIFFERENTIAL PISTON incorporated in a valve design can use the line pressure in a water main as power for driving the piston. This is accomplished by using a piston which has half as much exposed area on the small end as that of the large end.

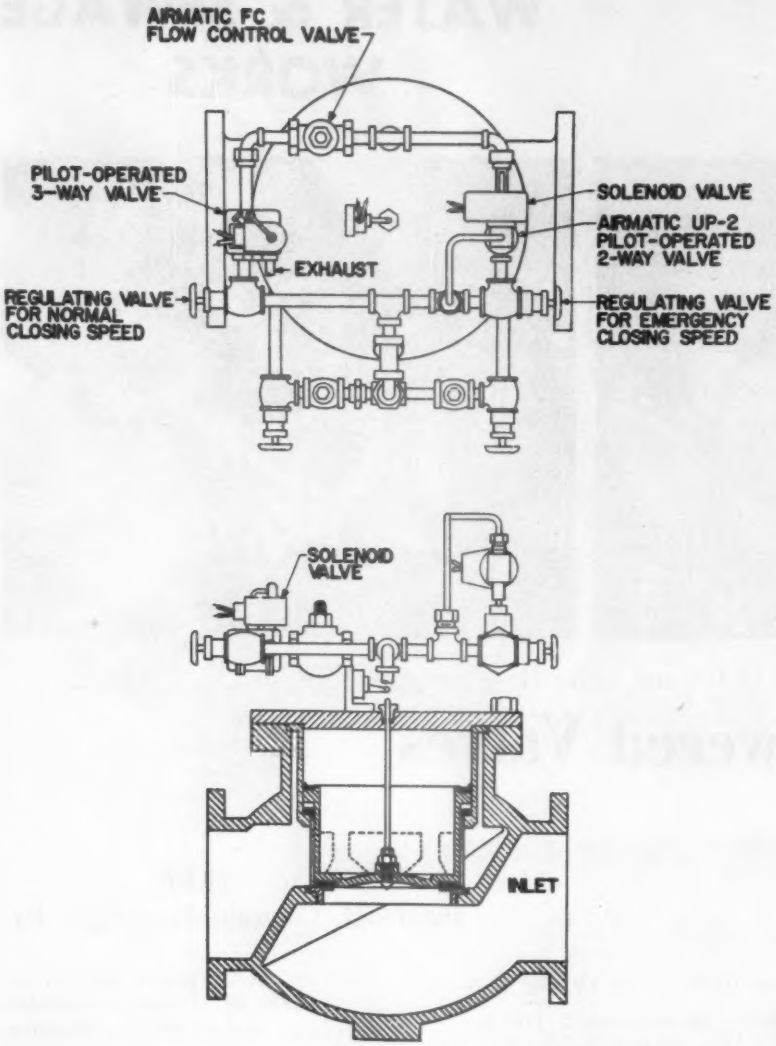
In considering a 24-inch gate valve located on a 100 psi line, the 452 sq. in. disc face would have a pressure of 45,200 lbs against it. To open the valve, it is necessary to overcome this pressure. Manually, two men are normally needed to turn a hand wheel about 150 revolutions to open or close the valve.

By employing a differential-piston whose small end has an exposed area of 452 sq. in., the aforementioned force is available to open the valve. By making the surface area of the large end of the piston 904 sq. in., then 90,400 lbs of force is available to oppose the 45,200 lbs, therefore providing a net force of 45,200 lbs to drive the piston in the other direction and in this case close the valve.

Since the small end of piston actually closes off the flow in the pipe, the controls or pilot system for operating this valve must be centered on the large end of the piston. If the line pressure to the enclosed large end of the piston is closed off and a pilot valve allows the area within the enclosure to be exhausted, the unopposed force on the small end of piston will drive it up and the valve will be open.

To close the valve, the exhaust valve on the pilot system enclosing the large end of the piston is closed and pressure from the main is released forcing the piston down to close the valve.

Large valves ranging in size up to 36 inches can be opened or closed by



Courtesy Golden Anderson Valve Spec. Co.

FIG. 1. PLAN VIEW (top) and vertical section (bottom) illustrate and identify components of valve.

the pilot system which in turn merely controls the presence or absence of pressure on the large end of the differential-piston. These controls can be one-hand manual, push-button solenoid-operated hydraulic or automatic. Automatic operation is provided by solenoid-actuated pilot valves where some electrical occurrence, such as starting or stopping of a pump, energizes the solenoids.

Valve Description

The lead illustrations are of valve installations on the municipal water supply system at Cuyahoga Falls, Ohio and are of the automatic type. These valves were manufactured by the Golden Anderson Valve Specialty Co., Pittsburgh, Pa. The layout of these valves are shown in Figure 1. On top of the main valves is a hydraulic circuit employing two check valves, two pilot-operated valves (actuated by two solenoid valves), and a flow control valve. A header carries line pressure fluid to the top of the piston valve. The line splits; one line leads to a three-way solenoid-operated valve, then through a flow-control valve to a "T" which leads to the top side of the differential piston. This is the control circuit for normal operation of the main valve. The other line splitting off from the header is for emergency operation. It leads through a two-way pilot operated valve and on to the "T" which leads to the top of the differential piston. The solenoid valve mounted directly above the two-way valve (on a fluid line leading from the split header line to the valve) may be electrically connected to a limit switch which in turn may be pressure actuated by a pressure switch or time-relay pilot.

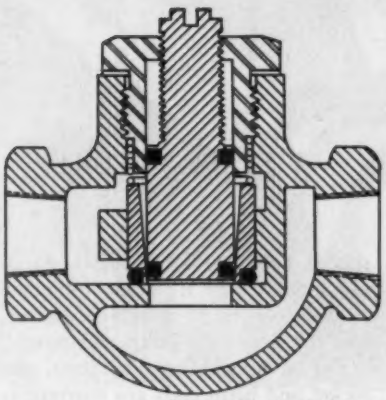
This main line valve and its arrangement of accessory pilot and soleniod valves provides for automatic opening of the valve after pumps are started, and closure of the valve before pumps are stopped.

Ohio Installation

Two such valves are installed on 8-inch water lines which supply an elevated portion of Cuyahoga Falls. Water is pumped through the valves to a 750,000 gal. storage tank. When storage pressure drops to 57 lbs, the pumps kick on and the valves open automatically. After a pressure of 85 lbs has been achieved, the valve closes and then the pumps stop. This kills surge and prevents the loss of high-pressure water from the main system.

The accessory flow control valve is a critical component since it regulates the opening speed of the main valve. This flow control valve, manufactured by Airmatic Valve, Inc., Cleveland, Ohio, employs a large metering stem whose diameter is greater than that of the inlet and outlet parts (Figure 2). This stem differs from the usual needle valve in that it provides considerable more orifice area and thus eliminates much of the usual pressure loss. The large diameter annular orifice allows for extremely fine flow adjustment which can be maintained in spite of pressure changes. When flow occurs in the opposite direction, the poppet lifts off its seat and the fluid passes without impedance through the flow control (regulation for flow in this direction is provided by a needle valve). The usual O-ring and bevel seat design provides for leak-free closing of the poppet.

The emergency control circuit employs a UP-2 two-way universal pilot-operated valve shown in Figure 3. This valve duplicates in miniature the design of the large valve in that it



Courtesy Airmatic Valve, Inc.

FIG. 2. FLOW-CONTROL VALVE has unusually large diameter metering stem instead of conventional needle.

also employs the differential-piston principle. Thus, static line pressure applied to the top of the poppet (the piston) assures leak-free sealing indefinitely. When line pressure is removed from the top of the poppet, due to opening of the solenoid mounted above, a spring provides breakaway force and pressure from the fluid flow assists in maintaining the poppet in the open position.

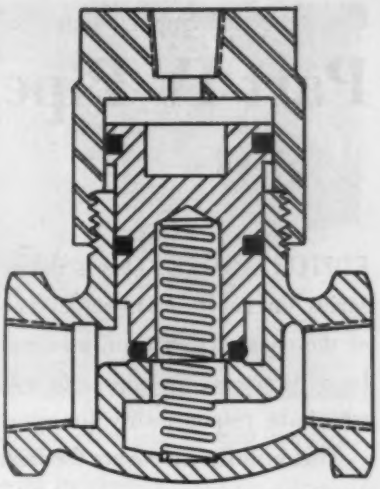
Valve Operating Sequence

The sequence of operation for normal valve opening starts when the pump start button is depressed. The pump motor starter circuit, the solenoid of the three-way valve, and the solenoid of the two-way pilot valve are simultaneously energized. When the solenoid of the three-way pilot valve is energized, it permits exhaust from the top of the differential piston, which begins to move off its seat due to line pressure. The opening speed is regulated by adjustment of the flow-control valve in the pilot line. As pressure underneath the main-valve piston moves it into the open position a position-indicator rod interlocks a limit switch with the pump motor starter circuit.

Normal valve closing is begun by depressing a stop button which de-energizes the solenoid-operated three-way pilot. The pump motor-starter circuit remains in contact because the limit switch contacts are still closed. When the solenoid above the three-way valve is de-energized, the line pressure is admitted to the top of the differential piston, which immediately starts to move into the closed position at a controlled rate of speed as governed by adjustment of a needle flow-regulating valve on the three-way inlet valve line. With fluid moving into the top of the main valve, the poppet in the flow-control opens, so that closing speed is regulated only by the needle valve. When the valve is almost fully closed, the limit switch actuated by the valve-piston indicator-rod breaks contacts in the motor-starter circuit, shutting down the pump motor. The main-valve piston travels the remaining distance to close the valve tight.

Emergency Operation

Emergency valve closing is provided automatically in the event of a power failure. The motor-starter circuit and the solenoids of both pilot valves become de-energized simultaneously which opens both pilot valves to admit fluid to the top of the main valve piston, causing it to move rapidly to its seat. Since both pilot valves are admitting fluid, the



Courtesy Airmatic Valve, Inc.

FIG. 3. UNIVERSAL PILOT-OPERATED valve also employs differential-piston principle. Static line pressure applied to top of piston gives leak-proof sealing.

closing speed is always at a faster rate than that of the normal closing speed. Emergency speed adjustment is provided by a needle regulating valve on the two-way valve inlet line. Emergency closing will happen in event of motor under-voltage or overload, or by depressing the emergency stop button.

Manual valve opening, after emergency closing, is done by pressing a manual-operator handle which is attached to the three-way pilot valve. The manual operator can be locked in closed position and will hold the main valve open as long as desired. When the manual operator is released, the main-valve piston will immediately start to move again into the closed position at a controlled rate of speed.

Report of Ohio Flood Control Projects Published

A report on 131 existing or proposed flood control and protection projects in the State has just been released by the Division of Water, Department of Natural Resources. Prepared by Miles M. Dawson, Brigadier General, U.S. Army (ret.), consultant engineer for the Division, as a part of a State-wide flood survey, the report presents data on projects of the Corps of Engineers, Soil Conservation Service, conservancy districts, and the State.

Over $100,000,000 has been spent on 32 government reservoirs and 6 local protection projects. Another $30,000,000 is represented in projects under construction. Another $68,000,000 is in authorized projects on which construction has not been started; $112,000,000 in deferred projects for restudy, and $111,000,000 in inactive projects, many of which probably will not be built due to problems of financing or lack of local interest.

The total flood control programs including all agencies would total close to half a billion dollars if carried out according to plans now available.

Studies now underway on new projects could up this figure considerably, the report indicates.

The study was prepared as a part of an emergency flood survey instigated by the State following the floods of last January. The Division of Water is currently preparing more detailed and comprehensive plans for each of the major watershed areas.

The report contains 130 pages, including 69 engineering illustrations of projects. A map, 28″ x 29″, is included which shows location and status of all projects.

The report is available at $1.00, or the map separately at 25c, per copy from Division of Water, 1562 West First Avenue, Columbus 12, Ohio.

Construction Supervision

Part IV Pipe Jointing

A STAFF REPORT

EDITOR'S NOTE: This is the fourth installment in a continuing series on construction supervision. Written from the viewpoint of the construction man, information in this series is designed to be of practical usefulness to water and sewage works personnel who have responsibility for construction and major repair work.

This installment covers the installation of certain types of joints used in various types of water and sewage pipe lines. Preceding installments dealt with receiving, inspection and handling of pipe; trench preparation and pipe bedding; handling of pipe into the trench; and the installation of "rubber" joints.

■ PROPER INSTALLATION of the joints in a water or sewage pipe line is a vitally important part of the construction process, requiring close supervision and careful inspection. A wide variety of joint types are available for use with different kinds of pipe and to fit various conditions. Of great importance are joints which incorporate rubber gaskets; these joints were covered in detail in the preceding installment (September issue). Other types are discussed in detail here; for convenience, they have been grouped as follows:

1. Mechanical Joints
2. Couplings
3. Welded Joints
4. Poured Joints
5. Mortar Joints

Mechanical Joints

The term *mechanical joint* is a broad one, but has come to be associated with one type of joint most commonly used with cast iron pipe. It is based on an adaptation of the stuffing-box principle. As shown in figure 1, it consists of a socket, or special bell, provided with a flange cast integral with it; a cast iron gland or follower ring; a rubber gasket; and the necessary bolts and nuts.

Before assembling the joint, the socket and plain ends are thoroughly cleaned and then painted with a soapy solution. The rubber gasket is coated with the same solution. The gland is moved into position against the face of the gasket. Bolts are inserted and nuts made finger-tight. Using a ratchet or torque wrench, bolts are then brought to uniform tightness all around the joint, tightening alternately bolts 180 degrees apart.

As an additional factor of safety against possible joint separation at bends or under similar conditions, glands are available which are fitted with set screws. The set screws are mounted radially on the rear of the gland, and tighten against the outer walls of the plain end of the pipe.

While the set screw gland is a precautionary measure for holding a bend or a tee when used in a bulkhead position, the usual and most commonly used method —where the direction of flow is changed—is to brace the fitting with either poured concrete or concrete blocks.

Courtesy James B. Clow & Sons and Lynchburg Foundry Co.

THIS SEQUENCE of photos shows clearly—from left to right—the sequence of operations involved in installing a typical rubber gasket (slip-type) joint in a cast iron pipe line. This type of joint was discussed in detail in Part III of this series (September issue).

Courtesy Cast Iron Pipe Research Assn.

FIGURE 1. FIELD ASSEMBLY of a mechanical joint for cast iron pipe. Note flange, rubber gasket, gland, and bolts and nuts.

Courtesy American Cast Iron Pipe Co.

FIGURE 2. A typical ball-and-socket joint for cast iron pipe, intended for use under difficult conditions, particularly for river crossings or submarine installations.

Ball-and-Socket Joints

A special type of mechanical joint is the ball and socket joint, which is specifically recommended for difficult conditions, particularly for river crossings or submarine installations. As shown in figure 2, distinctive feature of a joint of this type is the ball-shaped spigot end assembly designed to roll in the spherical socket; this arrangement provides a bend in any direction with deflections up to 15 degrees. A rubber gasket is provided between the two halves of the factory-assembled ball.

Flanged Joints

Here, flanged joints are classed as mechanical joints because of their general nature. They are used principally on steel, cast iron, and wrought iron. For these joints, each end of a pipe section is provided with a flange, which is either threaded or welded to the pipe. A gasket is placed between the flanges and the flanges bolted together.

Couplings

Under this heading, attention is focused principally upon couplings used with steel, cast iron, and wrought iron pipe. Attention is also given briefly to couplings used with plastic and asbestos cement pipe.

Dresser Couplings

The conventional type of Dresser coupling (Style 38) as shown in figure 3, consists of two flanges, two gaskets, a middle ring, and the necessary bolts and nuts. The joints may be assembled on the bank and the coupled sections lowered into the trench, or coupling may be done in the trench, depending largely on the size of the pipe. The various elements of the coupling are assembled, the pipes butted together, and the bolts drawn up tight. It is important that uniform compression of the gaskets be obtained; this is done by pulling bolts opposite one another up a little at a time until all are drawn to the limit.

The Dresser coupling provides a certain amount of flexibility in the joint, so that pipe can be laid on horizontal and vertical curves. It also provides for expansion and contraction in the line. In the usual case, the joint is used as shown, without additional restraint. In cases of unanchored bends or other circumstances where cumulative movement through the coupling must be prevented, an additional "harness" may be used; a typical harness consists of additional bolts which connect either the two pipe sections, thus putting compression on the middle ring of the coupling, or the middle ring to each of the pipe sections, alternately.

A "boltless" Dresser coupling has been developed and is used on occasion.

Dresser couplings are frequently protected by the field application of a hot coal tar enamel, after the coupling has been assembled. A special coating pan is used to cover the lower half of the joint, and the coating is done under carefully controlled conditions.

Victaulic Couplings

A Victaulic coupling is a clamp-

Courtesy Steel Plate Fabricators Assn.

FIGURE 3. FIELD INSTALLED Dresser coupling.

type mechanical joint made up of two or more segmental housings which are bolted together. The housing encloses a U-shaped rubber gasket, and locks the two ends of the pipe together to prevent longitudinal movement. The joint provides some degree of flexibility. The ends of the pipe must be specially prepared for the use of this type of coupling—by shouldering, grooving or welding adapters to the pipe ends.

Couplings For Plastic Pipe

Plastic pipe in small sizes (up to about 6 inches in diameter) is being used for water and sewer lines. Adjoining pipe sections are joined with a special sleeve coupling. The union may be made as follows.

1. Cut off pipe ends squarely.
2. Clean the outside of the pipe and the inside of the plastic coupling.
3. Using a brush, coat the inside of the fitting and the outside of the pipe with a special "welding" solution.
4. Fitting and pipe ends are then joined in order to make a butt joint. Time must be allowed for the joint to set before reaching its ultimate strength.

Couplings for Asbestos Cement Pipe

Couplings used for asbestos cement pipe were described in the preceding installment of this series, under the general category of rubber joints.

Step-by-step procedure for field installation of one type of coupling for asbestos-cement pipe is shown in figure 4.

Welded Joints

Steel pipe sections are often welded in the field, using conventional welding methods. Types of welded joints which have been used include

1. Butt joints (Single or double welded).
2. Belled end slip joints (Single or double welded).
3. Butt-strap joint, which is used only under heavy service conditions.

Field welding must be done by experienced welders under careful supervision; applicable welding codes are widely used for control purposes.

Line tension in a welded pipeline may be relieved by the provision of Dresser couplings or welded slip joints at intervals of 500 feet or so along the pipe. Butt joints are used between these stress-relieving joints. When this scheme is used, slip joints are welded out of sequence. That is, the butt welds are made first. Later, when the temperature has dropped as low as anticipated, the slip joints are welded. This puts the continuously welded section in compression, which does no damage to the pipe itself. The thrust of such compression is relieved by expansion joints adjacent to pumps, valves, fixed structures, and so on.

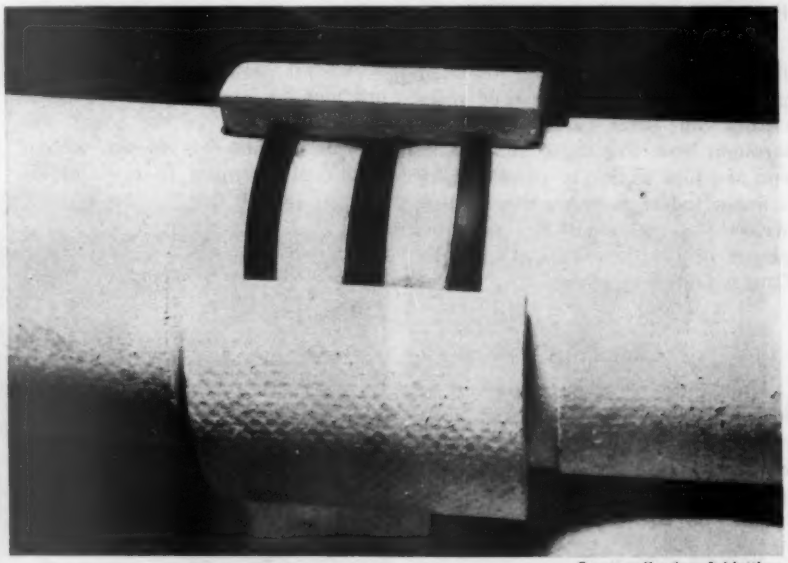
Courtesy Steel Plate Fabricators Assn.

FIELD WELDING of steel pipe line.

Poured Joints

In previous years, poured joints were widely used in water and sewage pipelines with certain types of pipe. Today, they are much less frequently used, but still are either required or permitted by some city building codes.

No attempt will be made here to cover all the types of materials and detailed methods which have been used in the past for poured joints. Attention will be given only to hot-poured joints, which are typical of this type of construction. Basic mate-



Courtesy Keasbey & Mattison

FIGURE 4. Method of installing Fluid-Tite joint, which makes use of one type of coupling to join two sections of asbestos-cement pipe. Spacing yokes are used during installation, as shown in left-hand view. On the right is a cutaway section of the completed joint, with rubber gaskets in place.

rials of consequence for this type of joint include some sort of yarning (e.g. jute or oakum) and a jointing compound which requires heating for application. The jointing compound frequently is lead.

Procedures for hot-poured joints vary somewhat depending on whether the line is to be under pressure or not.

An example of the procedure for making a hot poured joint in a non-pressure (gravity) line is that followed with clay pipe.

Principal steps in the formation of a hot-poured joint for clay pipe are shown in figure 5. Notes accompanying the drawings make additional explanation unnecessary. A similar procedure has been used in forming hot-poured joints for concrete pipe lines.

Photo Courtesy Alabama Pipe Co.

FLEXIBLE Altite joint permits easy lay-out and prevents damage from ground vibrators.

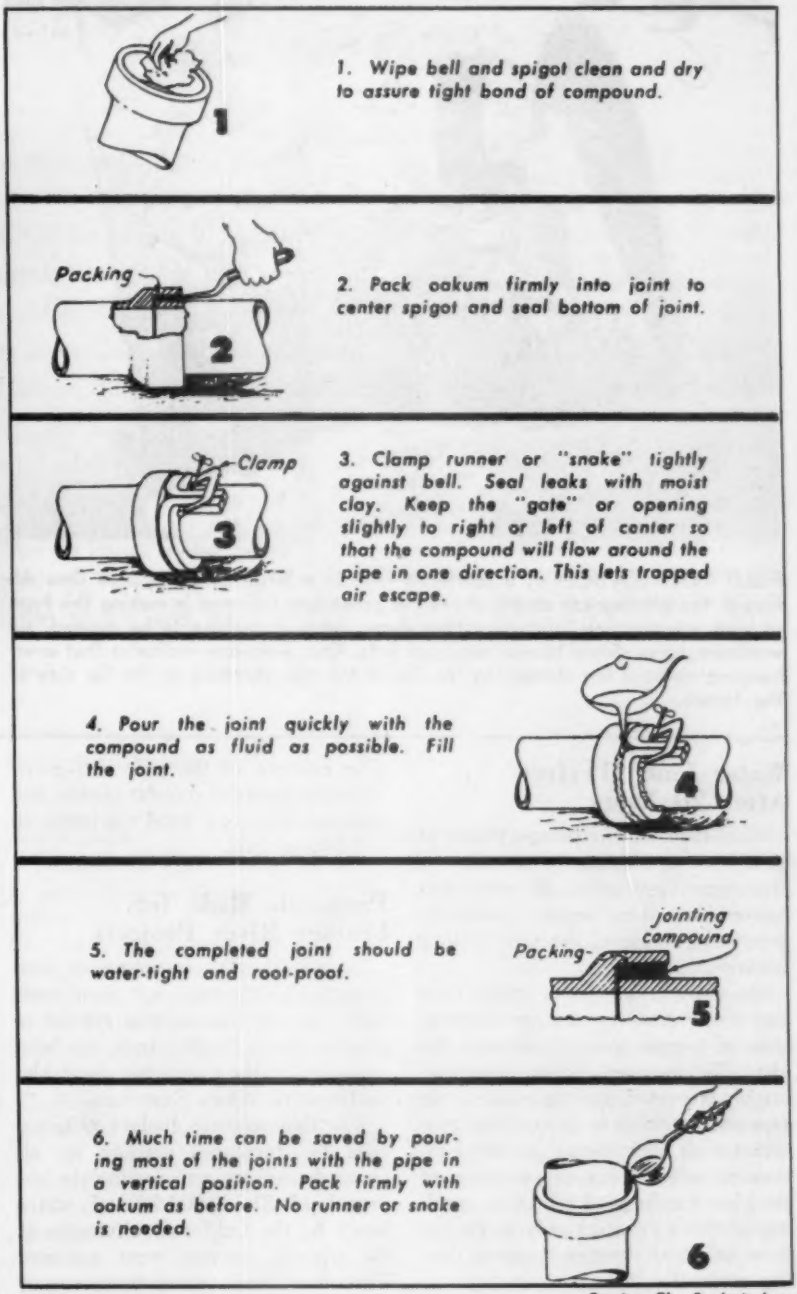
Steps shown in figure 5 are generally similar to those used for hot-poured lead joints in cast iron and asbestos cement pipe lines which will operate under pressure, with the exception of calking. An important difference is the calking of the lead compound into the joint after pouring. Calking is accomplished by the use of hand or pneumatic calking tools which are used to tamp the lead all the way around the pipe. Different sizes of calking tools are used in sequence. Excessive calking must be avoided to prevent splitting of the bells.

Cement Joints In Concrete Pipe Lines

Concrete pipe lines are often provided with cement mortar (or cement grout) joints; the mortar is applied in the field as the pipe sections are assembled. Practice varies and discussion here is based on typical methods of fashioning such joints.

Typical specifications call for a cement mortar to be composed of one part Portland cement and two parts sand with only enough water added to produce a stiff workable mixture.

In laying bell and spigot pipe, bell holes must be excavated in the trench bottom so that the pipe barrel bears uniformly. Before jointing the pipe ends are thoroughly cleaned and wetted with water. Mortar is then placed in the lower half of the bell of the pipe


1
1. Wipe bell and spigot clean and dry to assure tight bond of compound.
Packing
2
2. Pack oakum firmly into joint to center spigot and seal bottom of joint.
Clamp
3
3. Clamp runner or "snake" tightly against bell. Seal leaks with moist clay. Keep the "gate" or opening slightly to right or left of center so that the compound will flow around the pipe in one direction. This lets trapped air escape.
4. Pour the joint quickly with the compound as fluid as possible. Fill the joint.
4
5. The completed joint should be water-tight and root-proof.
jointing compound
Packing
5
6. Much time can be saved by pouring most of the joints with the pipe in a vertical position. Pack firmly with oakum as before. No runner or snake is needed.
6

Courtesy Clay Products Assn.

FIGURE 5. STEPS IN making a hot-poured joint between two sections of clay pipe.

Courtesy American Concrete Pipe Assn.

FIELD INSTALLATION of a mortared joint in a large concrete pipe line. Although the photograph clearly shows the procedure followed in making this type of joint, construction safety practices shown leave something to be desired. All workmen shown should be wearing hard hats. Also, a shadow indicates that overhanging material is endangering the life of the man standing on the far side of the trench.

section already in place. The spigot end of the next pipe is then inserted into the bell so that the sections are closely fitted and properly aligned. The remaining annular space in the bell is then filled with mortar sufficient to form a bead around the outside of the spigot end of the pipe. The inner surface of the pipe at the joint is then brushed and smoothed with a swab or long handled brush.

In laying tongue and groove pipe, the groove end is generally laid upstream. The ends of the pipe must be thoroughly cleaned and wetted. The bottom half of the groove end of the pipe already in place is buttered with mortar. A shallow excavation should be made under the pipe joint. This is filled with mortar into which the ends of the pipe bed when laid. The top of the tongue of the pipe to be laid is also buttered with mortar. The tongue end is then inserted into the groove end of the pipe in the ditch until mortar is squeezed out onto the inner and outer surfaces of the pipe. The inside of the pipe is brushed smooth and the outside pointed up with a bead of mortar. Occasionally a band of cloth, which has been dipped in cement mortar just prior to placing, is wrapped around the outside of the joint. The purpose of this cloth or diaper is to support the bead of mortar on the outside of the pipe while curing. A covering of moist earth, sand, wet canvas or burlap should be used to cure the joint.

Water Line "Perfect" After 20 Years

Coal-tar enamel coatings, placed on a 30-inch water line by the City of Tacoma, Washington, 20 years ago, have remained in "perfect" condition, permitting reuse of the pipe without additional coating.

Recently, a section of trunk main had to be removed during construction of a new freeway through the city. The removed section was thoroughly inspected, and the inside of the pipe was found to be in excellent condition with no evidence of deterioration or wear. Even the exterior of the pipe was in good condition, needing protective coating only at the cut lines or where damage occurred during removal.

When originally installed in 1939, the pipe was given a 3/32 inch spun coat of coal-tar enamel on the inside. The exterior of the pipe was given alternate layers of coal-tar enamel and asbestos felt to a total thickness of 7/32 of an inch.

Proposals Made for Feather River Projects

A $34,054,500 construction program for California's next fiscal year, with most of this amount related to Feather River Project items, has been proposed by the California State Department of Water Resources.

The department's budget proposal calls for increased activity on all planned projects, anticipating the approval of $1,750,000,000 of water bonds by the California electorate at the general election next autumn. These bond funds would finance most of the Feather River Project, a plan to deliver surplus water from the northern to the southern part of the state. The budget requests, taken into consideration by the State Department of Finance, include the following:

1—Funds to establish a public information staff of four employees to inform the electorate on the bond issue.

2—An appropriation of $21,396,400 for the Oroville, Butte County, division of the FRP. This would be used mostly for relocating the Western Pacific railroad around the Oroville Dam site.

3—Support for six new positions on the legal staff to handle the increasing work load relating to land acquisition, relocation of utilities, and construction contracts.

4—Funds for accelerated study programs on sea water conversion and nuclear engineering.

To meet additional demands, cities seek needed funds through . . .

Service Charges *for sanitary sewers*

by C. H. HOPER, C. H. Hoper & Co., Utility Engineers, Denver, Colo.

RESUME: City responsibilities toward maintaining better schools, recreation programs, etc, have pretty well exhausted funds obtained through established methods. Cities are forced to examine other sources for revenue to meet requirements.

Payment for the use of sewers is a logical approach toward maintaining, operating, and expanding this utility, similar to such charges levied by any other utility. Charges should reflect actual costs and be spread equitably among all users.

Rate structures based on water consumption either by flat rates per family or industry, or established on metered water consumption are fair methods for establishing sewer service charges. Additional regulations should be evolved to prevent the discharge of deleterious substances to the sewers and surcharges made for extra strength sewage.

■ SANITARY SEWER SERVICE CHARGES are not a new method of obtaining revenue. Brockton, Mass. adopted an ordinance providing for such charges in 1894, but only recently has there been a widespread adoption of this method.

Why have cities been adopting these charges? A number of reasons can be given.

Cities generally are starved for ad valorem tax revenues as a direct result of the inflation since World War II. Costs of everything that cities have to buy have skyrocketed and then compounding this effect has been the desire and need for additional services. Providing for and handling additional traffic and comprehensive recreation programs may be cited as a few of these services. Schools are largely limited to property taxes. Comparisons of school vs. city levies in most cities reveal that schools have taken over this source of revenue for their operating and expansion needs. Cities as a result have had to examine other sources of revenue to meet their requirements.

Perhaps the most important factor in promoting the adoption of sewer service charges or rates is the need for additions or improvements to sewage treatment plants. The American people have become increasingly conscious of the pollution, particularly of our surface waters. Great strides have been made since the adoption of the Federal Water Pollution Control law with which you are all familiar. Even with Federal assistance the major cost of additions and improvements to treatment plants must be borne by cities. The cost of installing the sanitary sewer collection systems is largely met from special assessments or directly by subdivision developers. Operating costs of simple collection systems in many cases are sufficiently low so that such costs are not usually much of a problem. This is not true, however, when considering the outfall and treatment facilities, costs of which are difficult to handle either from ad valorem taxes or from special assessments.

In many states there are limits on the amount of general obligation bonds a city may issue. If sewer treatment plants are financed from general obligation bonds, other vital needs of the city may not be met. Because of the limitations in the issuance of general obligation bonds and in the practical inability to secure enough tax revenue to retire them, cities rather logically have turned to revenue bonds as a means of financing these treatment plant additions or improvements. Revenue bonds in turn normally result in sewer service charges.

Another factor in the movement toward sewer service charges has been the population expansion which has been occurring quite generally in our cities. This expansion has necessitated not only sewage treatment facilities but in many instances new trunks, relief sewers and outfall lines, all of which involve financing problems.

Another factor perhaps in the adoption of sewer service charges is the increasing recognition that sanitary service is in essentially the same category as water service or the services rendered by other utilities.

It may be of interest to learn how widespread the adoption of sewer charges has become. Table XIII in the 1958 *Municipal Year Book* issued by The International City Manager's Association is a convenient source for this information. The information in

Table 1 has been taken from this publication and shows the number of cities in various population groups which finance their sewers and disposal plants by means of revenue bonds and special revenue funds as compared with the total cities reporting. It is assumed the special revenue funds are derived principally from sewer service charges.

It will be noted that excepting for the largest cities, 26 per cent of those cities reporting financed their sewer systems by "special revenue funds".

TABLE I
CITY FINANCING, SIZE VS. TOTAL REPORTING

Size of City	Number Reporting	Financing by Rev. Bonds & Spec. Rev. Funds	Per Cent
Over 1,000,000	4	0	0
500,000-1,000,000	7	1	14.3
250,000-500,000	16	4	25.0
100,000-250,000	26	6	23.1
50,000-100,000	59	18	30.5
25,000-50,000	112	28	25.0
10,000-25,000	236	62	26.3

Factors Affecting Charges

No schedule of sewer service charges fit all cities. There are many factors which must be considered in establishing the correct basis of charges or schedule or rates. It is difficult to find the same identical conditions existing in two cities.

First of all, the capital costs of sanitary sewer facilities vary greatly. Some collection systems involve considerable pumping by lift stations. In others, sewage flow is entirely by gravity. In some cities, storm and sanitary sewage are combined. Outfall facilities differ widely. Perhaps the biggest difference between sewer systems, other than where sanitary and storm sewers are combined, lies in the treatment facilities. Costs and their distribution to users vary with the character and extent of treatment. This treatment may consist of lagoons which are ideal in some circumstances, primary treatment, and the various units designed to result in so-called complete treatment. Plants vary as to the amount of pumpage involved and costs are different where sludge filters are used rather than digestion tanks. Sewer service charges should be evolved to reflect these different capital costs.

Operation and maintenance costs vary with each of the types of systems mentioned. Some cities, particularly in the drier areas to the west, have serious tree root problems resulting in wide variations in sewer cleaning costs. All of these costs should be spread equitably between the users and this can be accomplished by conventional allocation methods.

An important factor bearing on sewer service rates is whether or not the sanitary sewer and water systems are under the same management. This bears not only upon the costs of administration and billing, but also on the collection of accounts. Still another factor which is used by some cities to advantage where revenue bonds are issued is the cross-pledging of water and sewer revenues. This may operate to reduce debt service coverage (to be discussed later) and thus perhaps permit a lower level of combined charges.

Sewer service charges are often determined by whether or not water service is billed on a flat or metered basis. There are many who feel that flat rates for water service are evidence of a backward community. However, there are cases where flat rates are not only permissible but desirable. Considerable space could be used discussing this item, but it is really outside the scope of this paper. Flat water rates, however, are in effect and are naturally reflected in the establishment of sewer service charges.

Sanitary sewer systems are financed from general obligation bonds, revenue bonds, special assessments, current funds, or by grants-in-aid. There are cities where sanitary sewer collection systems have been financed from sewer service charges. These charges would naturally be quite different than cities where these costs are paid from special assessments or from ad valorem taxes, either directly or by means of general obligation bonds.

At this point it might be desirable to discuss briefly the point of view expressed in the literature to the effect that "non-users" should bear their fair share of the costs of a sanitary sewer system. It is no doubt equitable to charge these non-users via special assessments for construction of sanitary sewer facilities, normally the collection system. For reasons already stated, it is perhaps wishful thinking in most cases to desire to assess costs to non-users via the ad valorem tax route.

Another factor bearing upon the particular service charges established is the policy toward extension of service to users beyond the city's corporate limits. Some cities extend sanitary sewer service in an effort to protect the health of their own citizens. There are a number of theories upon which these out-of-city charges can be based. Perhaps the most commonly accepted one is that of calculating costs on a utility basis under which full consideration is given to the cost of the facilities used or useful in providing service to these out-of-city customers to include full operating, maintenance and depreciation costs, plus interest costs on money invested. Some cities go so far as to collect a profit, which is a policy matter.

Unless sewer service charges are evolved solely from the standpoint of raising a certain amount of revenue, all of the foregoing factors should be taken into consideration and reflected in these charges. It is apparent, for instance that the matter of sewer service charges cannot be isolated from the policy of extension of mains and facilities to new users. Connection charges are coming to be more widely used in water systems and could also be employed in meeting improvement or enlargement costs of sanitary sewer facilities. It may be considered a matter of policy whether present users of sewage service should be called upon for increased rates traceable directly to the extending of service to additional users. Cities could with propriety

ask for a connection charge additional to the cost of the installation of the extension of the collection system which would defray the cost of additional trunk sewers and disposal facilities. Such connection charges, however, cannot well be relied upon to meet debt service requirements.

Sewer service charges are but a part of the overall financial program. The program should first be evolved and then sewer charges established to fit that program, anticipating costs for a reasonable future period. It can be safely stated that the general public is not usually happy where charges, such as sewer service charges, are amended every year or two. If revenue bonds are involved, it is quite essential that future anticipated costs be most carefully considered.

Rate Structures

The ideal rate structure can be considered as the one which spreads all costs fairly between users, both as to the small and the large user, and which also takes into consideration the character of use. Proper rates take into consideration extra costs incurred through the handling of unusual sewage.

The two principal service charge categories are *flat* and *metered*. Where the individual user of sewage service is furnished water on a flat rate basis or water meter readings are not available. Such as in the case of separately managed systems, billing for sewer service charges must be made on a flat rate basis. Ordinarily where flat water rates are employed, they extend only to residential users. Where water meters are installed, sewer rates should be based upon metered water use, especially where the water and sewer departments are under the same administration.

Where flat rates are employed, they may be applied uniformly, they may be based upon inspections and counts of connections and fixtures, they may vary with the property served, or they can be predicted upon the size of water tap. A per family basis has been used for many years in determining sanitary sewer charges where water is billed on flat rate schedules. This basis has been found much simpler to establish and enforce and has eliminated the cost of expensive surveys to determine fixture counts. Rates should be as simple as possible and yet achieve the desired end results. Even where residential flat rates for water service are employed, water meters are usually available for determination of use by commercial and industrial users.

Metered rates for sewage service should normally be based upon water usage. Sewer meters are often installed for measuring sanitary sewage from the larger users and are particularly necessary in measuring sewerage generated, say, by a suburban area where individual water billing data are not available.

Normally metered rates can either be based upon the water meter size, be computed as a percentage of water bills or a separate schedule of use be established. Basing charges upon the water meter size may be quite fallacious where water pressures vary widely, particularly as they do in hilly cities. If sewer rates are tied to water bills, it would be a coincidence if costs are apportioned fairly between all users of water and sewage service. If it is desired to spread these costs fairly, it can perhaps best be done by a separate schedule of rates.

Basing sewer service charges on water use over each month of the year may create an appreciable problem in areas where considerable lawn sprinkling is done. In instances it may be necessary to determine an annual sewer service cost based upon water use during periods of the year when no sprinkling is done.

Provision must be made in any schedule of rates for sanitary sewer service for those users which obtain all or part of their water supply from private wells or other sources. It is necessary in these instances to measure this water either regularly by separate meter or by periodic check to determine the proper sewer charges. Provisions should also be made for those cases where metered water is used directly in manufacturing process or is discharged to other than the sanitary sewer system. It could be considered a matter of city policy whether or not charges should be made for the use of the storm sewers when such water is discharged to them.

A problem in rate mechanics is sometimes incurred where revenue bonds are issued and where little need exists for year to year expenditures for capital additions and improvements. Revenue bond buyers look for what is termed "debt service coverage". After all normal operating and maintenance costs have been met, for safety's sake there should be an excess remaining to meet bond interest and retirement requirements. If this excess is 50 percent, the debt service coverage is 150 percent. The excess may be used for capital additions on a pay-as-you-go basis or may be used to retire additional bonds. The reference to bonds is related entirely to serial bonds with overall terms well within the expected life of the improvements financed.

Industrial Wastes

There are a number of methods under which a city can equitably handle wastes other than sanitary sewage. Some special users may be periodically discharging volumes of waste water which tax the capacity of the collection system. Rather than exact higher rates from these users, they could be required to provide the necessary equalizing storage. This requirement for storage could be included in the city's ordinance provisions.

Other users may discharge materials such as plating wastes, paunch refuse from packing plants, hair, chicken feathers, or wastes which are either strongly acid or alkaline, etc. The city could require that all substances deleterious to its sewer system be removed from the sewage prior to discharge to the system.

Various industries may discharge wastes which are not deleterious in the sense already mentioned but which involve additional treatment costs. The reference is to sewage of higher than normal BOD and/or settleable solids. There have been a number of formulae adopted to reflect additional charges for sewer service involving such wastes. No formulae are presented here because these costs would vary with the particular type and degree of treatment involved. Any schedule of sewer service charges should provide for the computation of additional costs predicated upon the actual costs of the system as to capital, operation, and maintenance. No credit should be allowed where plain water is dumped into the sanitary sewer system since

this problem is normally solved by proper water rates.

Periodic surveys and appropriate tests are required to administer properly to sewer discharges of deleterious materials and charging for extra strength sewage.

Billing and Collection

No discussion of sanitary sewer charges would be complete without at least mentioning billing procedures and collection charges. Billing for sewage service should, if possible, be combined with water billing and both collected as a single unit. Collection is customarily enforced by turning off the water service. Where statutes permit, unpaid bills may be levied against the property affected.

Conclusions

The establishment of sanitary sewer service charges has quite naturally resulted from revenue problems all cities are facing, coupled with increasing health standards necessitating adequate sewage treatment. As is evidient from the many varying factors in different cities and sewer systems, there is no simple rate schedule which can be adopted in every instance. Unless sewer service charges are evolved purely to raise needed revenues, these charges should reflect actual costs and these costs should be spread equitably between all users. Flat rates may be necessary in some instances but generally where water meters are employed these meter readings should be used for basing rates on water consumption. Regulations should be adopted preventing the discharge of deleterious substances to the sewer system and surcharges should be made to defray the additional costs of extra strength sewage.

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Water Quality Management Course Slated for Feb. 29

The Robert A. Taft Sanitary Engineering Center of the Public Health Service has announced a special training course on Water Quality Management—Sanitary Engineering Aspects, to be held at the Cincinnati laboratory February 29 to March 11. Admission to the course is by application only, and the number accepted is limited by the facilities available. Application forms may be obtained from the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio. No tuition or registration fee is charged.

The course is offered for sanitary engineers and others with responsibilities in the administration of water quality management programs. Emphasis is placed on the broad principles of effective protection and management of water resources. Specific problems and their solution are considered from the viewpoint of the total administrative effort. The biological, chemical, and bacteriological phases of sanitary engineering practices are integrated with the engineering aspects. Various types of wastes are discussed from the standpoint of their effect on the quality of the receiving water, the appropriate parameters for measurement of that effect, and the steps to be taken in the elimination of the waste material. Traditional waste measurement parameters such as DO, BOD, COD are reviewed and evaluated in the light of present conditions. New problems, created by the increased use of synthetic organic chemicals, insecticides, and radioactive isotopes are studied. Water supply problems, such as taste and odor, coagulation difficulties and nuisance organisms are considered.

Because of the urgent need for conservation of water resources, the possibilty of reclamation of saline waters, the reduction of reservoir evaporation, and the recharging of ground water supplies are investigated. The administration of stream pollution control programs and the interpretation of data are discussed.

Opportunity for presentation and discussion of trainee problems is provided in panel discussions. Panels made up of trainees are organized to study and report on basic problems associated with water quality management. Assignment to panels is made prior to the course and is based on trainee experience and interest.

The general organization of the course is as follows: (1) basic principles of water quality management; (2) sewage-type wastes; oxygen-associated aspects, microbiological aspects; (3) non-sewage type wastes; inorganic wastes, radioactive wastes; (4) water supply problems: taste and odor problems, coagulation, efficiency of treatment processes, current research projects; (5) general engineering; water resources, collection of information, administration.

A new approach to water tunnel design is the use of . . .

Nickel Copper Alloy Expansion Joints

by P. J. McCOY AND B. P. HEALY
Chief Civil Eng. and Principal Struct. Eng.,
Burnes and Roe Inc., New York, N. Y.

EDITOR'S NOTE: Although the particular application described here is on the discharge tunnels of an electric generating plant the possible application of this idea to water and sewerage problems should make this article of interest to WATER & SEWAGE WORKS readers.

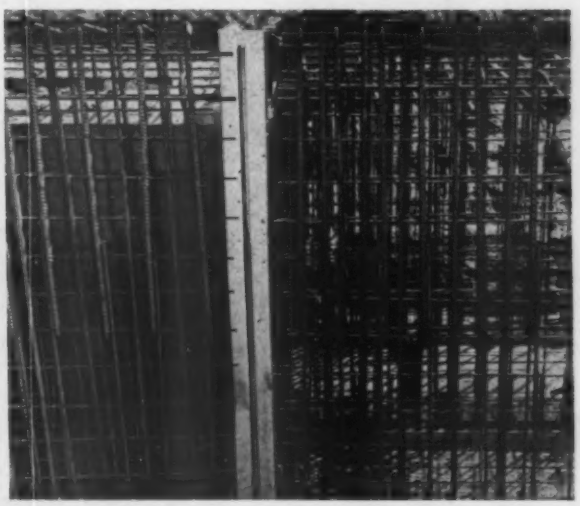
■ THE TWO DISCHARGE tunnels from the new Thomas H. Allen Electric Generating station, Memphis, Tenn are 4000 ft long by 13 ft square with a design capacity of 750,000 gpm each. They are designed to act during part of the year as a siphon in order to avoid a possible additional pumping charge at certain times of the year. Leaking through concrete cracks or poor joints had to be prevented, so the installation of piling was considered to eliminate the cracking which might result from uneven settlement of the tunnel.

In order to save the cost of such a foundation, an alternate design of an articulated, or jointed type tunnel was selected. This design employs Monel* alloys as the waterstop material at flexible joints, spaced about 50 ft apart, to provide pressure tightness, and flexibility under possible conditions of opening and closing of the joints. Monel alloy is approximately ⅔ nickel and ⅓ copper. Produced by the International Nickel Company, Inc., it provides corrosion resistance, high tensile strength (about 78,000 psi), and a high modulus of elasticity. The coefficient of linear expansion of the alloy is .0000078 in. per in. per deg F. This compares very closely with the linear expansion coefficients of both steel and concretes, thus reducing the danger of warping and cracking under extreme temperature changes. Such damage is most likely to occur during construction when the structures are exposed to hot sun for a considerable time before completion.

*Registered Trademark The International Nickel Co., Inc.

The expansion joint material is Monel nickel-copper alloy, hot rolled, annealed and pickled, roofing quality sheet in accordance with ASTM Designation B-127-58T "Nickel-Copper Alloy; Plate, Sheet and Strip". The material is 25 gauge U. S. Standand, 0.021 in., 16-oz per sq ft. Width of the expansion joints was prefabricated to fit the contour of the joints and then bent in accordance with detailed drawings.

The expansion joints are approximately 15 in. wide, formed with a U-shaped section at the center and with the edges bent with a minimum radius of ½ in. It was required that the material in the expansion joints be furnished in the maximum available lengths, to minimize soldering and riveting. All joints were pretinned and lapped at least 1 in., riveted with 4 Monel rivets and soldered, to make them continuous and watertight. The solder contained a minimum of 50% tin and the remainder lead. The "U" is packed with a premolded sheet filler and the joint is beveled ½ in. and finished with joint-sealer.



THE JOINTS were prepared by a sheet metal and roofing contractor. The width of the joints was prefabricated to fit the contours of the joints, then bent in accordance with detailed drawings (left) and installed (right).

Part 18 of this series on centrifugal pump design, construction and maintenance concludes the subject of . . .

Vertical Pumps — *Part III*

by IGOR J. KARASSIK, Consulting Eng. and Manager of Planning, Harrison Div., Worthington Corp., Harrison, N. J.

EDITOR'S NOTE: This third of three parts on vertical pumps deals with wet-pit sewage, volute, and sump pumps. The previous sections dealt with driver mounting, shaft selection and mounting, dry-well units, and wet-pit units of turbine propeller, and modified propeller types. With this 18th part the series on pumps and their accessories, from the viewpoints of design, construction and maintenance, is concluded.

Wet-Pit Sewage Pumps

Except for some large vertical propeller-type pumps handling dilute sewage (basically storm water contaminated by domestic sewage), vertical wet-pit sewage pumps are of the bottom-suction volute type with impellers capable of handling solids and stringy materials with minimum clogging. This type pump is usually suspended from a higher floor by means of a drop pipe and often employs covered or enclosed-type shafting as used in vertical turbine pumps. They are provided with a bellmouth suction inlet and changes in bearing and stuffing box construction. Otherwise, these pumps are usually hydraulically and mechanically similar to their dry-pit counterparts.

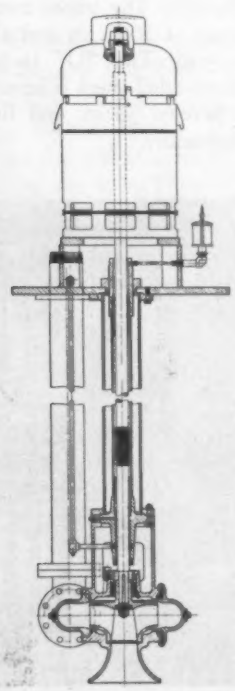


FIG. 1. SECTION of vertical wet-pit sewage or non-clogging pump.

Three basic constructions have been used for this type of pump. The first, with impellers without back rings, employs a water-or grease-lubricated bearing with a seal at its lower end, immediately above the impeller. The upper end is vented to the suction pit to prevent any appreciable hydraulic pressure on the seal at the lower end of the shaft cover pipe; otherwise, water will work into the cover pipe. The seal at the lower end of the impeller bearing must be effective, especially with high pump heads; otherwise, there will be considerable leakage of water through the bearing, with some cutting if grit is present in the liquid. A second construction is similar, but employs pump-out vanes or wearing ring joints on the back side of the impeller (the latter necessitating balance holes through the impeller hub), so that the bearing is subjected only to suction pressure. A third type of construction, used primarily with impellers having no back rings or pump-out vanes, retains a stuffing box in some form, with bearings above the stuffing box and separated from it.

Although shaft seals and packing used to seal the lower end of the cover pipe or bottom bearing are intended to exclude water as much as possible, some leakage of liquid with higher suction water levels is to be expected, even when the seal is new. Some of the shaft bearings may have

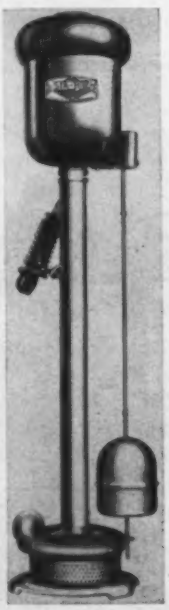


FIG. 2. TYPICAL cellar drainer sump pump.

Courtesy Starite Co.

to operate in water or in a mixture of oil and water, so that the bearing may wear relatively faster than one positively lubricated with oil or grease. In general, wet-pit sewage pumps should be limited to services requiring operation for a very limited period of the day.

Wet-Pit Volute Pumps

In addition to the more common wet-pit sewage pumps previously discussed, which are also volute pumps, there have been various installations of volute pumps: some single suction, with either bottom or top suction; others double suction, supported on the pit floor. Except for some floating drydock installations, this type of pump has little modern application.

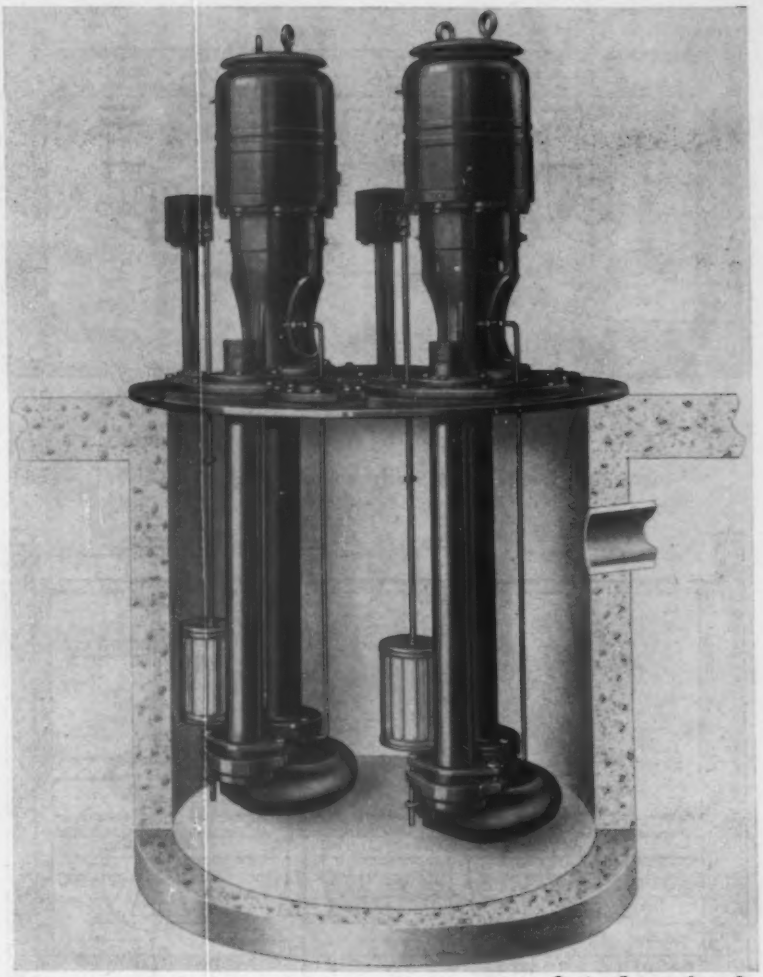
Sump Pumps

The term "sump" pump generally conveys the idea of a vertical wet-pit pump suspended from a floor plate or sump cover, or supported by a foot on the bottom of a well, usually motor-driven and automatically controlled by a float switch, to remove drainage collected in a sump. The term does not indicate any specific type of construction, as both diffuser and volute type, single- or multi-stage, with open and closed impellers of a wide range in specific speed type, have been employed for this service.

For the very small capacity field, where fractional horsepower motors can be used, "cellar drainers" can be obtained. These are small, usually single-stage volute pumps, with single-suction impellers, either bottom or top suction, supported by a foot on the casing, with the motor supported some distance above by some form of column enclosing the shaft. Such cellar drainers are made as complete units, with float, float switch, motor and strainers completely assembled as a unit (Fig. 2).

Larger capacity sump pumps may be of the vertical propeller or turbine pump type (single- or multi-stage), or of the vertical wet-pit sewage or volute type. Where solids or other waste materials may be washed into the sump, the vertical wet-pit sewage pump with a non-clogging type of impeller is preferred for such sump pump service.

The larger capacity sump pumps are usually more or less standard de-



Courtesy Economy Pump Co.

FIG. 3. TYPICAL duplex sump pump.

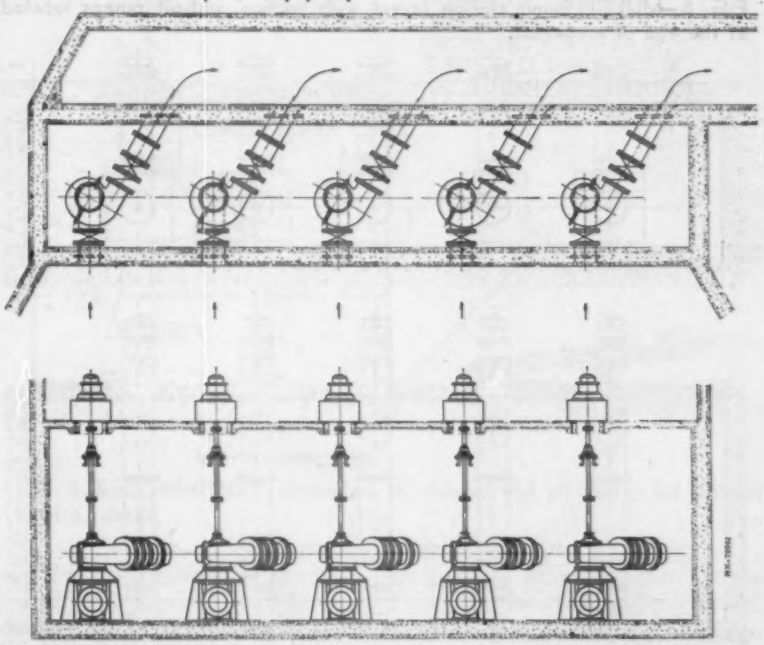


FIG. 4. MULTIPLE-unit station layout with vertical dry-pit volute pumps installed lengthwise along a long suction bay.

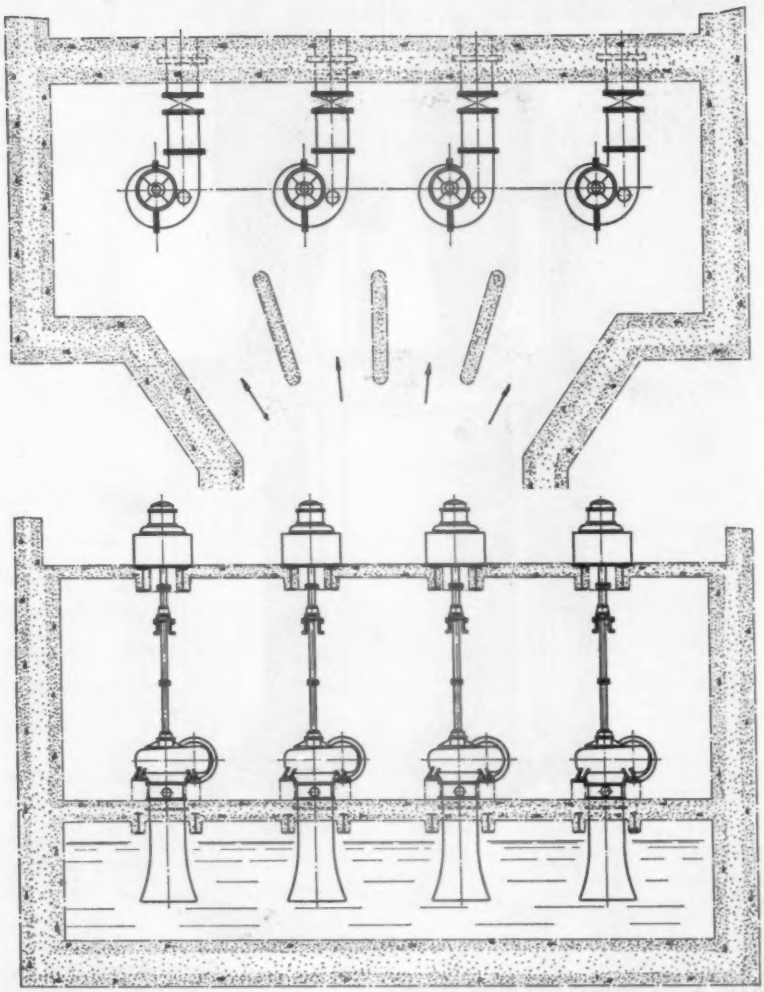


FIG. 5. MULTIPLE-unit station layout with vertical wet-pit pumps located at the end of a conduit.

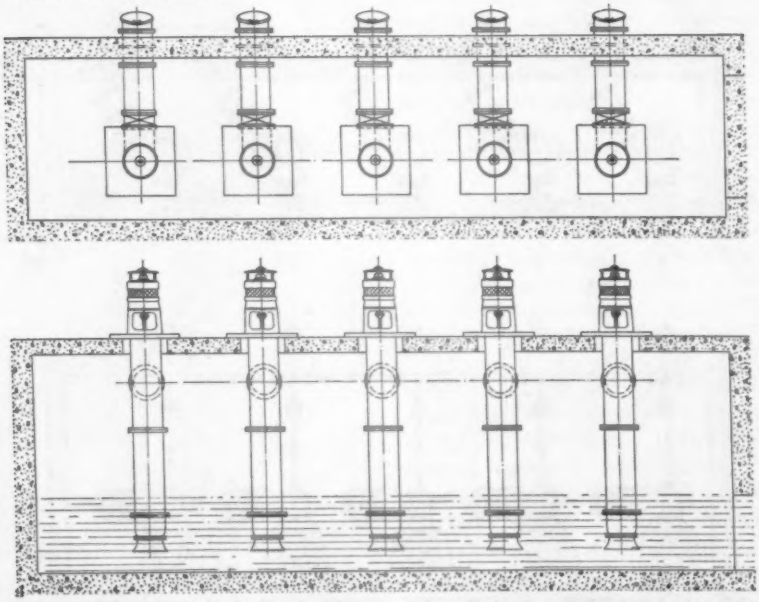


FIG. 6. MULTIPLE-unit station layout of vertical propeller pumps with the suction supply from one end of the well can cause difficulties.

signs, but obtainable in any length, with various size sump covers, float switch mounted on the sump cover, etc. Often duplex units (that is, two pumps on a common sump cover, possibly with a manhole for access to the sump) are used (Fig. 3). Such duplex units may have the pumps operate in a fixed order, or a mechanical or electrical alternator can be used to equalize the operation of the two pumps.

Application of Vertical Wet-Pit Pumps

Like all other pumps, the vertical wet-pit type has advantages and disadvantages, the former being mostly hydraulic and the latter mechanical. With the impeller (or first-stage impeller in case of multi-stage pumps) submerged, there is no priming problem, and the pump can be automatically controlled, with no concern that the unit will ever run dry. Also being submerged, the net positive suction head, in cases other than a closed tank, is greater, often permitting a higher rotating speed for the same service conditions. The only mechanical advantage is that the motor or drier can be located at any desired height above any floor level. The mechanical disadvantages are: possibility of freezing when idle; possibility of damage by floating objects if installed in an open ditch or similar installation; inconvenience of pulling and dismantling for inspection and repairs, no matter how small; and, finally, relatively short life of the pump bearings unless the water conditions and bearing design are ideal. The vertical wet-pit pump is the best for some applications; not ideal, but most economical for other installations; a poor choice for others; and least desirable for still other cases.

Typical Arrangements of Vertical Pumps

A pump is only part of a pumping system. The hydraulic design of the system external to the pump will be reflected in the over-all economy of the installation. Only too easily can the design of the installation have an adverse effect on the performance of the pump or pumps. This is particularly true in the case of vertical pumps, because the small floor space occupied by each unit offers the temp-

tation to reduce the size of the station by placing the units closer together. In such cases the suction arrangement may not permit the proper flow of water to the pump suction intake. Many factors are involved in the design of a suction well and the location of a bellmouth. No simple rules or relations can be applied with complete assurance; therefore, none are included in this discussion. The physical size of the pumps, whether of the propeller or volute type, rarely affects the design of the suction well, the location of the bellmouth, or the spacing of the units. These are usually controlled by the factors governing the proper flow of the water to the bellmouth.

Fig. 4 illustrates an ideal arrangement for a multiple-unit station with dry-pit pumps. It provides an unrestricted flow on the suction side of all the units. Often, stations using this arrangement for a group of vertical volute pumps have the suction bellmouths and elbows formed right in the concrete substructure.

When wet-pit pumps are installed with vertical bellmouths, adequate clearance must be provided from the back wall and between the units, as in Fig. 5, which illustrates a common situation in which the suction is located at the end of a conduit whose width is less than the length of the suction well. Without a flared section with division walls to guide the distribution of the incoming water to the various units, the flow would be badly distributed and the operation of the pumps affected unfavorably.

An arrangement which is often troublesome with propeller pumps (and with vertical volute pumps provided with suction bellmouths as in Fig. 5) is shown on Fig. 6. Unless the width of the suction well gives sufficient area and unless the locations of the bellmouths permit good flow, the demand of the units first in line will disturb the flow of the units further from the supply conduit. Installations of this general arrangement often require extensive baffling to correct the distribution to the various units. To overcome the problem of such a layout, some stations are made with walls forming individual wells for each pump, with a channel to supply them running lengthwise of the station. Certain recommendations have been developed over the years for the dimensioning of intake channels and approaches. Wherever possible, an intake as illustrated in Fig. 7 will give excellent results. The dimensions of channel width and spacing are given in terms of the suction bellmouth diameter. An example of good channel and pit design for vertical turbine pumps is also given in Fig. 8. It will be noted that

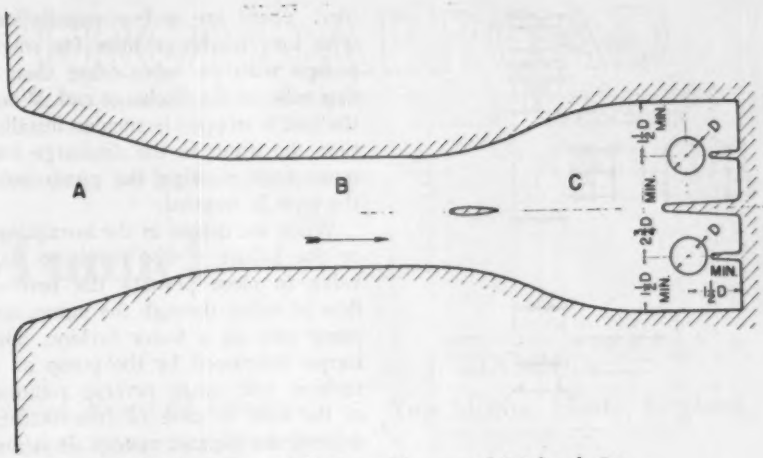


FIG. 7. TYPICAL pump installation with a good intake design.

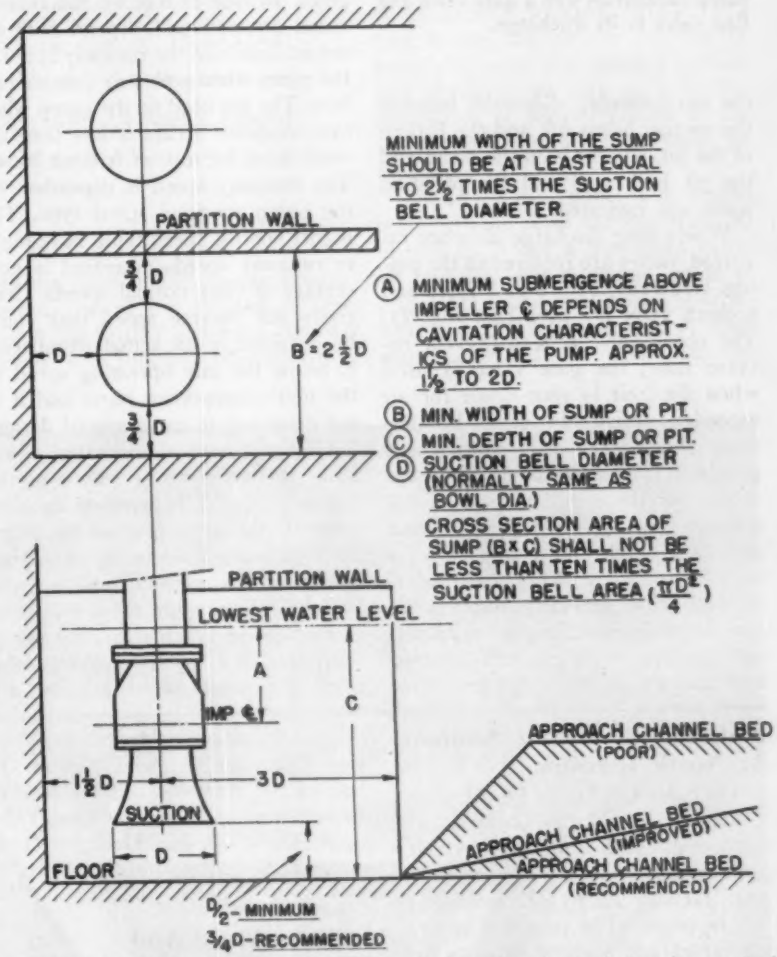

MINIMUM WIDTH OF THE SUMP SHOULD BE AT LEAST EQUAL TO 2½ TIMES THE SUCTION BELL DIAMETER.
PARTITION WALL
¾D
D
B = 2½D
¾D
(A) MINIMUM SUBMERGENCE ABOVE IMPELLER ℄ DEPENDS ON CAVITATION CHARACTERISTICS OF THE PUMP. APPROX. 1½ TO 2D.
(B) MIN. WIDTH OF SUMP OR PIT.
(C) MIN. DEPTH OF SUMP OR PIT.
(D) SUCTION BELL DIAMETER (NORMALLY SAME AS BOWL DIA.)
CROSS SECTION AREA OF SUMP (B x C) SHALL NOT BE LESS THAN TEN TIMES THE SUCTION BELL AREA ($\frac{\pi D^2}{4}$)
PARTITION WALL
LOWEST WATER LEVEL
A
C
IMP ℄
1½D
3D
SUCTION
D
FLOOR
APPROACH CHANNEL BED (POOR)
APPROACH CHANNEL BED (IMPROVED)
APPROACH CHANNEL BED (RECOMMENDED)
D/2 - MINIMUM
¾D - RECOMMENDED

FIG. 8. RECOMMENDED dimensions of channel and pit design for vertical turbine pumps.

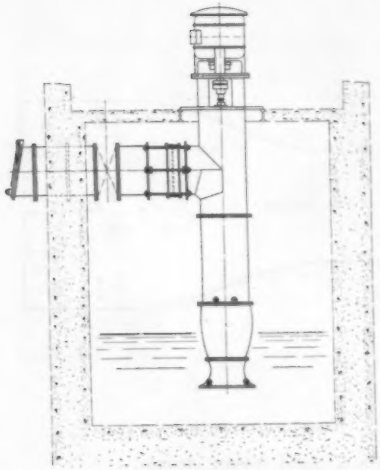


FIG. 9. VERTICAL wet-pit propeller pump installation with a gate valve and flap valve in its discharge.

the recommended clearances between the suction bellmouth and the bottom of the pit, and between the pump and the pit back wall and the partition walls, are indicated.

Where long discharge lines are involved, valves are required in the piping. Generally, both a gate valve and a check valve are used (see Fig. 9). The check valve acts to prevent reverse flow; the gate valve is used when the unit is shut down for an extended period. In some installations, the gate valve is omitted and provision is made in the design of the station for the use of stop planks or a sluice gate. A cone-type valve that acts as a check and a stop valve is used for some installations. However, its high cost generally restricts its use to those installations in which the flow has to be gradually started and stopped to prevent water hammer. There are a few installations with long discharge lines for single pumps with no valve other than a flap valve at the discharge end. When the unit is stopped in such an installation, the water in the discharge line flows back through the pump until the pipe is emptied.

When the design of the installation or the failure of the check or flap valve to close permits the reverse flow of water through the pump, the pump acts as a water turbine. The torque developed by the pump as a turbine will cause reverse rotation of the unit in case of free-rotating drivers like electric motors. It is not generally sufficient to cause reverse rotation for internal combustion engines. In case of motors, the reverse speed attained will depend both on the net head and the runaway speed of the pump when acting as a water turbine. The net head on the pump when this condition occurs is less than the static head because of friction losses. The runaway speed is dependent on the pump specified speed type. The higher specific speed types have higher runaway speeds measured in percentage of their normal speeds. Generally the reverse speed that could be obtained in an actual installation is below the safe operating speed of the unit's component parts and it is not necessary to use a special design.

Use of a syphon discharge eliminates the necessity of valves in the discharge line. The invert of the high point of the syphon must be above the high-water level on the discharge to break the syphon and prevent backflow of the water when the pump is shut down. When starting a pump operating on a syphon discharge, the usual procedure is to exhaust air

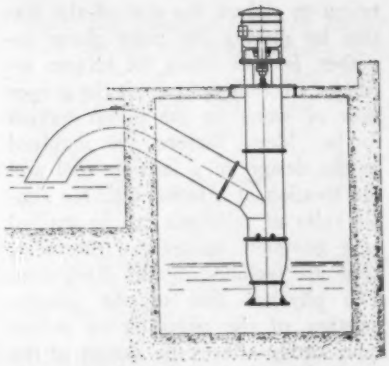


FIG. 10. VERTICAL wet-pit propeller pump installation with syphon discharge.

from the system by some priming device until the pump is primed. The pump may then be started to aid in filling the syphon. The connection to the high point of the syphon is also provided with a valved opening so air can be admitted and the syphon broken when it is desired to stop the unit. It is possible to have this admission of air automatically controlled so that it functions if the unit stops for any reason.

Although syphons with short legs are relatively simple and little trouble is experienced in their design or operation, more care must be taken as the syphon leg is lengthened. Although there are successfully operating syphons with legs over 25 feet in length, they are primarily limited to power plant installations on circulating water systems. A syphon discharge is desirable in drainage installations pumping over a levee and results in a lower head than would be obtained if the water were discharged at the top of the levee.

Radiological Health Seminar At North Carolina

The School of Public Health of the University of North Carolina will conduct its Sixth Radiological Health Seminar at Chapel Hill, North Carolina, January 25 to 27. Instruction will be provided by means of lecture, laboratory and seminar sessions that will range in subject matter from the basic phenomena of radioactivity to health department responsibilities for its control.

Among the distinguished speakers will be: Dr. Elda Anderson and Roy J. Morton of the Oak Ridge National Laboratory; Dr. Donald R. Chadwick, Executive Secretary of the Federal Radiation Council; Newton I. Sax of the New York State Health Department; and Doctors Norm Tellis, A. D. Wolff, and Henry Rechen of the U.S. Public Health Service.

Utilities Valve And Hydrant Requirements

Future U. S. utilities requirements for iron-body bronze-mounted gate valves and hydrants are incorporated in a comprehensive study released by the Business and Defense Services Administration's Water and Sewerage Industry and Utilities Division. Intended as a guide for utility executives, technical associations and manufacturers, the study groups valve requirements into three size classes, 2—12", 14—24" and over 24" diameters.

More than 800,000 tons of valves and nearly 600,000 tons of hydrants will be required by 1975 for new construction, maintenance and repair. Request "Water Utilities, Requirements for IBBM Gate Valves and Hydrants, 1940-1958-1975" from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 10 cents.

REPORT FROM ABROAD

Sydney, N.S.W. Australia meets demands by building a new . . .

Water Supply Tunnel

by J. GINDROD,
New Milton, Hants, England

EDITOR'S NOTE: A new 10-mile tunnel of 96 and 84 inch concrete lined steel pipe was installed at depths from 25 to 219 ft below ground level to supply additional water for Sydney. The construction was undertaken by the Metropolitan Water, Sewerage and Drainage Board at an estimated cost of £6,635,000 (approx. $18.6 mil.). The tunnel was blasted out of sandstone and shale by working in both directions from 13 shafts spaced at distances from 3,420 to 6,578 ft from each other.

■ THE PRINCIPAL WATER DISTRIBUTION conduit to the southern side of Sydney was a pressure tunnel, which delivered water from the two Potts Hill reservoirs. This conduit, a steel pipe 8 ft 3 inches in diameter concreted into a 10-mile long sandstone tunnel, terminates at the Waterloo pumping station and has connections also to the Crown Street reservoir and pumping station. The progressive increases in demand for water burdened the pressure tunnel to the limits of its capacity and the need for an additional conduit to augment supplies was being felt for some time.

A new tunnel was designed. This new City Tunnel conduit duplicates the existing tunnel and will draw its water from the same sources. Cross connections between the two tunnels will enable one to take over supply in the event of the other having to be closed for inspection or repair or in case of emergency. A 48-inch cross connection with another of Sydney's water supply networks (the Woronora system) will also be established.

Plans and Construction

Initially, the new City Tunnel will operate by gravitation in parallel with the older tunnel. In due course, however, when the demand on the system has further increased, the two tunnels will function independently. At this time the City Tunnel, because of its greater hydraulic grade, will then convey the greater quantity of water. To meet any demand beyond this, provision has been made for the installation of booster pumps at the Potts Hill reservoirs to increase its capacity.

The new City Tunnel is at depths below ground level varying from 50 to 219 ft. It has a maximum grade of 1 in 100 and minimum grade of 1 in 2,000. Of its total length, approximately 27,056 ft. was driven in sandstone, 21,179 ft. in shale and the

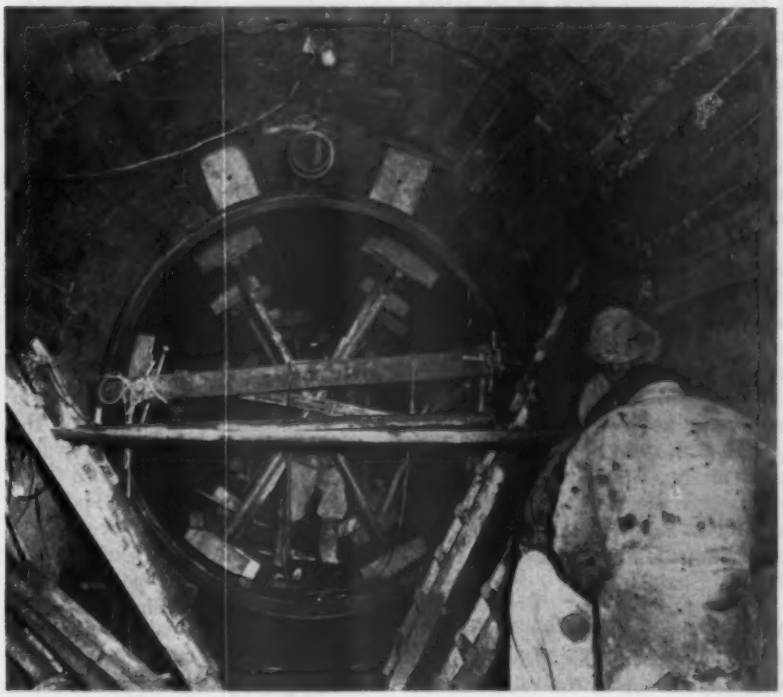


FIG. 1. TEN MILE TUNNEL will require 27,542 ft of 96 inch diameter pipe to line one section.

FIG. 2. SPOIL being removed by shovel-type loader.

remainder in a mixture of both materials. Excavation totalled 216,730 cu yds and the completed 10-mile conduit will comprise 27,542 ft of 96 inch diameter pipe between Potts Hill and Ashfield and 27,404 ft of 84 inch diameter pipe for the remainder of its length.

Work on the tunnel was begun toward the end of 1946 when 13 sites were selected for the various shafts. The shaft head plant, comprising hoisting winches and poppit heads, compressors, electric sub-stations and spoil bins for the temporary storage of excavated material were then installed, together with facilities for the staff engaged up on the project.

Excavation was carried out from all 13 shafts and the distances between them ranged from 3,420 ft to 6,578 ft. Tunnels were driven simultaneously in opposite directions from each side of a shaft, the longest drive being approximately 3,730 ft. Each gang was divided into a drilling and mucking group. Spoil was removed at each shaft by a shovel-type loader and hauled from both faces by an electric locomotive.

On October 8, 1954, excavation was completed in the eastern drive of Shaft 1 when the break-through was effected into the completed western drive from Shaft 2. The error in the center lines was ¼ in and the difference in level also ¼ in. This represents a very fine effort on the part of the surveyors responsible, particularly as the work was carried out in a section on a grade of 1 in 3 and with a horizontal deflection at the bottom of the grade some 3,120 ft from Shaft 2.

Drilling and Blasting

Drilling for the explosive charges was carried out in the rock face by either pneumatic drills, jack hammers, or drifters. Most of the tunnelling was done by the heavier drills which were jumbo mounted. Alloy steel detachable bits and drill steels with tungsten carbide tips integral with the steel were largely used.

When working in shale it was the practice to drill 28 to 32 holes per round and to use about 35 lb of 60 per cent ammonium nitrate geligite as explosive. Sandstone required about 45 holes and 45 lb of explosive. Holes averaged 7 ft in depth, giv- an advance of about five feet when the face has been fired. Progress averaged about 25 feet per week at each face.

Firing of the explosive was carried out by means of electric delay action detonators. Such firing enabled the whole face to be brought out in one round and gave very good fragmentation of the rock. During each firing and before wiring of the face was completed, all men were withdrawn to the surface. The circuit was then tested, the safety fuses placed in the panel and the firing button pressed. All blasts were fired by an exploder operating through a transformer from the power main. The switch was arranged so that while loading was in operation the firing mains were automatically short circuited, thus eliminating the danger of a premature explosion.

Spoil Removal

After firing, the broken rock or shale was loaded into mining trucks by mechanical loaders. The loaders operated by compressed air and the trucks ran on 2 ft guage tracks. The 9 cu ft capacity loader bucket dug into the spoil heap at the face, passed its load overhead and deposited it into the mining truck at the rate of 30 cu ft a minute.

For transport of the spoil, the single 2 ft guage, 45 lb rail track was placed along the center of each drive. A long turnout at each side of the shafts provided for the passing and shunting of the trucks etc. Passing bays were also provided at intervals and a portable passing loop was kept within 30 ft of the face during clearing operations. Ahead of this portable loop loose rails were pushed into the spoil to enable the loader to move forward as cleaning-up proceeded.

Hauling the trucks etc., were 3-ton electric locomotives driven by 8 h p motors powered by 60 volt storage batteries. These locomotives had a speed of 4½ m p h and each could haul a load of up to 25 tons, the usual burden being 10 trucks totalling 18 tons. On arrival at the shaft, the mining trucks were loaded singly into the cage and raised to elevated 80 cu yd capacity spoil bins on the surface. These bins were fitted with gear to facilitate the tipping of the spoil from the mining trucks. Thence, the spoil was discharged into road transport vehicles. The demand for fill by local councils and other interested parties was such that they arranged to haul spoil away without cost to the Metropolitan Water, Sewerage and Drainage Board.

Health and Safety

To eliminate the hazards arising from the silica dust during rock excavation ventilation on a considerable scale was installed into the tunnelling, at least 6,500 cu ft of air per minute being supplied to each shaft in order to rapidly clear each tunnel face after blasting. The fans were located at the shaft head and could be regulated either to discharge or take in air at the working face. After firing it was usual to place the fan on discharge so that the dust and fumes could be quickly eliminated.

As a further precaution against dust all drilling machines had a water spray to the point of the drill. Dust counts were taken frequently at each working face to determine if the silica content of the air was below the 200 particles per cu cm safe tolerance limit.

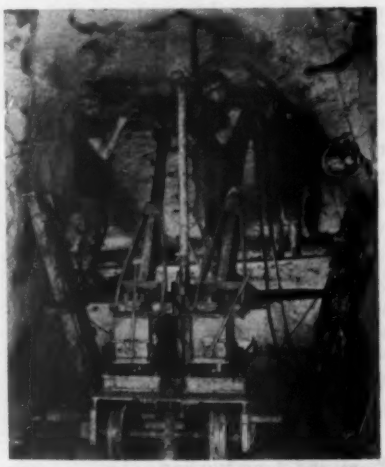


FIG. 3. JUMBO MOUNTED DRILLS made holes 7 ft in depth for placing explosives.

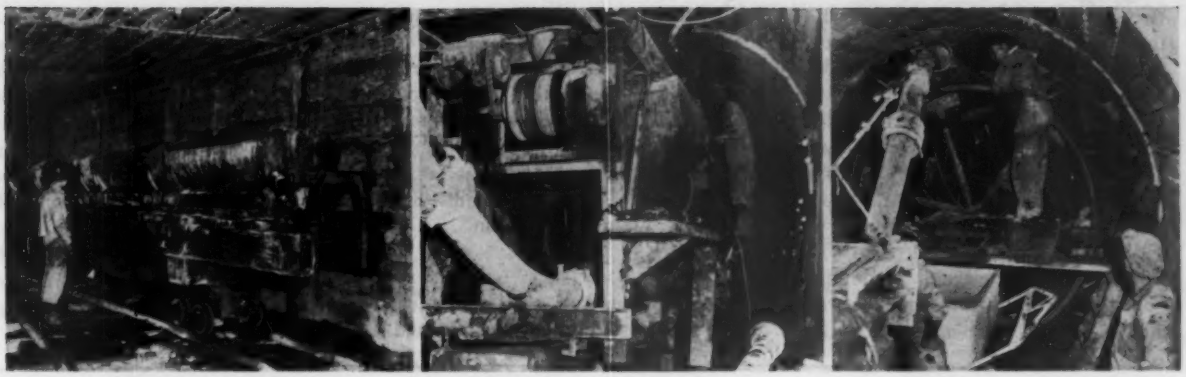


FIG. 4. CONCRETE SKIPS (left) are transported to hopper of concrete pump (center) where they are lifted by hydraulic hoist. (right) Concrete is pumped between pipe liners and tunnel walls.

The sections of the tunnel driven through shale were supported with steel ribs and timber sheeting. The former were joined either from 45 lb steel rails bent to a half horseshoe, butt jointed and bolted at the top, or 4 x 3 inch R.S.J. sections similarly treated and spaced at 4 ft centers. Outside these, 2-inch hardboard timbers were placed, but, with the lapse of time, these deteriorated under attacks of fungus and rot. To remedy this and to insure adequate support, the overbreak space behind the timber was packed with cement mortar pumped in under low pressure. The timber was then removed, leaving a strong shell to support the surrounding ground.

From the outset of the project, great importance was attached to safe working methods and preparedness against accident. To this end, a Safety Committee was set up under the chairmanship of the Resident Engineer. This included representatives of the employees. The committee met each month. Qualified first-aid men were employed at each working face and first-aid equipment was always kept at each shaft ready for use. A small safety gang was constantly examining all shafts and the tunnel for dangerous rock and unsafe timbering.

Tunnel Pipe

The steel pipes forming the tunnel lining were manufactured of steel in lengths of 12 ft and thicknesses varying between 7/16 and 9/16 inch according to the hydraulic pressures involved. They were provided with a bell shaped socket at one end to fit over a slightly splayed spigot. Each joint was internally welded after the pipe was placed in position. The pipes were lined with a 2 to 1 sand-cement mortar; the outside diameter of the barrel and the inside diameter of the cement lining being kept constant so that the lining thickness decreased as the plate thickness increased. The tunnel will require a total of 4,595 liners of which 2,295 will be of 96 inch diameter, the remaining 2,300 liners being of 84 inch diameter. Individual weights of liners vary between 4.3 and 6 tons according to diameter and plate thickness.

To enable pipe-laying to proceed at maximum speed, the overbreak in the floor of the tunnel was concreted as soon as possible after mining operations. A trackway was laid over the drain forced in the center of the floor by using steel sleepers. The steel liners were transported on this trackway to their laying points. The large cement-lined pipes were always lifted and not rolled. To retain their circular shape, each liner was fitted with six heavy screw-adjusted spiders, three at each end to give the necessary support. Liners were unloaded at the shaft surface by crane, either on to a stockpile or direct to the liner carriers. Liner carriers were four-wheeled frames mounted on rails and fitted with four screw jacks, each of which had a roller mounted on top.

An electric locomotive pushed the carrier with its liner into the liner cage, which was then lowered to the tunnel level, where another locomotive pushed the assembly to the laying point. There, the liner was adjusted for line and level and the socket pulled into the ball of the previously-laid pipe. Normally a distance of 1½ inch override was necessary for the two steel surfaces to closely engage for later welding. Precast concrete blocks were then placed under the liner and adjusted for level by concrete wedges. When two liners had been laid, they were secured against any tendency to move longitudinally by placing a beam across the end of the last liner and anchoring it to another beam placed in the gap of the cement lining four liners back.

The rate of pipe laying was gradually increased to four liners laid and concreted daily during a shift consisting of approximately 10 hrs.

Concrete Handling

To support the liner against deformation from either internal or external pressures and as a protection against corrosion, the space between the liners and walls of the tunnel was back-filled with concrete. This required about 93,000 cu yd of concrete.

At shafts 4 and 8 a portable concrete mixing plant was used. The plant could be dismantled or erected as separate complete floors. A second type of concrete plant, used at the other shafts, was moved as a unit to each shaft as required.

The portable concrete plant used at shafts 4 and 8 had aggregate bins at the top, fed by bucket elevators, which discharged to a weigh-batcher and thence to a 1 cu yd mixer. At the shaft head, a vertical flume hopper fed mixed concrete down the shaft into a transporter truck. This vehicle, carrying four bottom-discharge steel skips each of 20 cu ft capacity, was taken to the working face by electric locomotive. Here, the skips were transferred to a stationary truck with

two decks, the lower at the level of the skips on the transporter truck. A hydraulic hoist raised the skips to the upper deck where they were moved forward to dump their load into the hopper of the concrete pump. The empty skips were run to the rear of the top deck and down a ramp to be placed on the transporter truck and returned for a fresh load. The pump injects concrete through a 6-inch pipe into the space between the last liner laid and the tunnel walls. The steel liners were surrounded by a minimum thickness of 6 inches of concrete. Every fourth liner was provided with a drilled hole through which a pipe was inserted, before concreting. This pipe led to the tunnel roof so that grout could be injected to fill any cavities left after the pumping operation.

Final Touches

On completion of the concreting and grouting, the pipes were cleaned in preparation for welding. Successful welding requires very dry joints. Each joint was internally welded only, use being made of portable equipment carried along the tunnel and drawing its power from the main electric carrier line. A team of three welders worked in each gang, each man completing a fully welded joint daily. The gap in the lining at each joint was then filled with mortar to provide a continuous internal lining over the length of the conduit.

Planning Urged For Ohio River Basin

Lt. General E. C. Itschner said that the present navigation system is inadequate for the expected increase in waterway traffic and that increased activity will call for a considerable higher rate of water resources development. He called on State and local Government to act on three fronts to aid the Federal Government in developing the rivers potential, preventing damaging floods and providing adequate water supplies.

The New York State Natural Resources Committee Report

A report covering the period April 1, 1958 through December 31, 1958 has been submitted by the Joint Legislative Committee on Natural Resources, New York State, Senator Wheeler Milmoe, Chairman.

The report contains a review of 8 years of study of action on Natural Resources problems in New York State, as well as conclusions and recommendations of Joint Legislative Committee on Natural Resources. Developments in water resources and water rights as well as development in water pollution control in the state are presented. Air pollution progress is discussed in the report.

The report is known as Legislative Document (1959) No. 22 of the State of New York.

Booklet On Sanitary Engineering Manpower Available

A 32 page study covering miscellaneous factors of importance to the Sanitary Engineer has been released by USPHS. Reported are the results of a 1956-57 survey of 10,000 professional society members. Returns of 3961 respondents represent approximately two-thirds of the U. S. Sanitary Engineers holding degrees or registrations and working in the sanitary engineering field.

Importantly, it is shown that as of 1956 insufficient replacements are available to accommodate attrition in the upper age groups. The survey shows nearly 66 percent of the respondents are concerned primarily with water supply, waste treatment, or water pollution control. Median income from principal employment was shown by those reporting to be $8300.

Location of Sanitary Engineers closely matches the population proportion of certain geographic entities to the total population.

Copies of the report are available from the Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C. Ask for Public Health Service Publication No. 703.

Piatt Appointed Lecturer

Mr. Richard B. Piatt, Director of Finance, Metropolitan St. Louis Sewer District has been appointed a lecturer in Public Administration in the St. Louis University College of Arts and Sciences. A graduate of the University of Louisville, Kentucky he will teach a course in "Theory of Public Administration" in the Department of Political Science Graduate Program.

Philadelphia's Water Department

The Annual Report of Philadelphia's Water Department covering 1958 points out that the year was one of progress but with no major items brought to completion. New work advertised and bid during the calendar year 1958 amounted to 197 contracts for total value of $24,757,-046.

Average consumption of water for 1958 was 337 mgd compared with 352 mgd for 1957. The Delaware and Schuylkill Rivers continue to be the city's source of supply. New treatment plants at Torresdale and Queenlane, together with the new Belmont Plant scheduled for construction beginning in 1960 should provide Philadelphia with a high quality of water for many years. The water department serves a total of 520,306 customers having an average per capita consumption in 1958 of 154 gallons per day. The total sewerage in all three Philadelphia plants in 1958 averaged 300.4 mgd compared with 257.0 mgd for 1957. Plans are underway to expand the Northeast Plant beginning in 1961, but no capacity increase is planned for Southwest and Southeast plants within the next ten years.

Water Problems To Head ASCE Meeting

Civil engineering problems about water, its control and drainage, will feature the national convention program of the American Society of Civil Engineers to be held March 7-11, in New Orleans.

The emphasis on civil engineering water problems is demonstrated by the numerous technical papers scheduled for presentation. The Waterways and Harbors Division of the Society is sponsoring two sessions at which eight papers will be read, and it is also sponsoring three other sessions with the Construction Divisions where eleven papers will be offered. One of the three sessions of the Hydraulic Division will be devoted exclusively to flood control.

A State by State report on water problems, and many other interesting papers, were presented at this joint meeting. One session was devoted to . . .

Radioactive Monitoring and Electronic Computers

EDITOR's NOTE: New Orleans rolled out the welcome mat for over 1400 members of the Alabama-Mississippi and Southwest Section A.W.W.A. at their Joint Meeting.

The entertainment was highlighted by a moonlight ride and dance on the old Mississippi aboard the Sidewheel Steamer "President."

The 20 technical sessions provided a wealth of information and will serve as the basis for many a discussion during the coming year.

This report abstracts some of these interesting papers that were presented at this meeting.

■ ACTIVITIES OF THE CORPS of Engineers in water supply, Col. Langfitt B. Wilby, Deputy Division Engineer, U. S. Army Engineer Division, Lower Mississippi Valley. Indications are that United States population will pass 200,000,000 within 10 years and that by 1975 the country will be using water for all purposes totaling 1800 gallons per person per day. In 1960, total United States use will be approximately 300 mgd of which 60 million gallons will be derived from ground water sources. Decline of ground water level is of concern to the Corps of Engineers and studies have been conducted regarding the possibility of recharging underground aquifers from surplus surface supplies. Difficulties with recharge have been encountered from amount of suspended material in the water, entrained air and temperature if the recharge water is colder than the water occurring naturally in the aquifer.

Average annual precipitation for the nation is about 30" or about 13.2 million acre feet of water each day. Losses due to evaporation, transpiration and consumption permit the return of approximately 3.5 million acre feet per day to the oceans. A portion of the quantity is available for future development in our water resources program. Two thirds of the daily stream flow occurs as flood flow during a short period of the year. By storage and regulated release, it is economically possible to provide future constant availability of about 1.9 million acre feet equivalent to 630 billion gallons of suitable quality water for daily use. Consideration must be given to a reserved minimum to provide minimum flow purposes, for navigation and waste water disposal. The assumption is that approximately 315 mgd could be released for irrigation, domestic, industrial and farm uses.

WATER WORKS INVENTIONS, by Mr. John L. Ford, Sr, of the Ford Meter Box Company, Inc., Wabash, Indiana. Slides illustrated early means of pumping water from the ground and transporting it beginning in early Egyptian times, with man and animal power, to the evolution of steam, gasoline and electrical driven pumps. Early treatment procedures and the development of chemical feed devices was also illustrated. Of particular interest was the development of measuring devices for water flow and the evolvement of meters and accessories to indicate and record water volume.

MISSISSIPPI RIVER WATER QUALITY, by Ralph C. Palange of the Robert A. Taft Engineering Center, Cincinnati, Ohio. Reports from the water quality network indicate that the two most important contaminants found in the Mississippi river are chemical wastes and radioactive contaminants. Treatment means have not yet been found for some of the industrial wastes which in extremely low concentrations can cause taste and odor problems. Analytical means include the continued use of the carbon filter, chloroform, ether and alcohol extraction. Continuing analyses of water supplies over one year show the effect of tributary streams, communities and the time dilution effect of chemical contamination in the Mississippi river. The gross beta results reflect fall-out plus industrial and medical use of radioactive traces. The river shows no radical changes from head waters to its lower reaches. Strontium-90 analyses during the first half of 1959 are low and well below the maximum limits of 80 micromicrocuries. The reporting network will expand to 75 stations by 1960 with a future goal of 250 stations.

PANEL DISCUSSION OF THE RED RIVER COMPACT was conducted by Mr. C. T. Watts, Dept. of Public Works, Louisiana. Oklahoma, Arkansas, Texas, Louisiana all have present and future need for Red River water. Chairman of the Red River Compact Commission, Mr. Henry Beckman, Rolla, Missouri pointed out that the watershed covers 95 thousand square miles and that there may be water shortage in the upper reaches of the river with flooding as well as shortages in the lower reaches. Apportionment of the water can be by Supreme Court decree or voluntary compact. Each of the several states has representation and the Federal government representative is

a chairman. He has no vote and no preference. His task is to protect federal interests in the determinations of the compact. The group established an engineering and advisory committee to report on engineering aspects of the river basin. PL 660 added the feature of pollution control to PL 346, therefore, the Commission established a sub-committee under the engineering advisory committee to report on pollution problems in the river basin. Problems requiring consideration are shortages in the areas of little rainfall, and control of pollution (salt brine from oil wells) is particularly difficult from the standpoint of salt contamination due to pickup as the water flows over the land.

LEGAL ASPECTS OF THE COMMISSION'S OPERATION, by Mr. F. J. Borelli, Oklahoma City, Oklahoma. The Constitution authorizes compacts and places limitations on federal jurisdiction. Federal courts have jurisdiction and in such cases any agreements must consider the impact on the future activities of the states concerned. Normal considerations are the equitable apportionment of water, establish measuring means, determine preferential use, establish means of charging for losses due to evaporation, and to study, prevent and control pollution under the provisions of PL 660. Enforcement methods used by compact members must be decided by mutual agreement. Indian rights to water supplies have been given by prior agreement in some instances.

POTENTIALS AND PROBLEMS IN THE MUNICIPAL WASTES, by Mr. R. C. Palange, in the absence of Mr. B. E. Berger of the Robert A. Taft Engineering Center, Cincinnati, Ohio. Use of the dilution technique in strength reduction of municipal sewage may be a waste of a valuable natural resource. Reuse of treated sewage is unusual, the recent Chanute, Kansas experience being a case in point. In this case the city itself made the decision to reuse treated effluent as a source of potable water supply. Ottumwa, Iowa had the problem earlier due to low river flow and pollution from DesMoines located upstream. It is expected that water reuse will increase and will lead to a restudy of the concepts of water quality management. Modern methods render water acceptable technically, however, aesthetic approval has not been obtained. Activated sludge, a normally acceptable treatment process, is subject to upset and frothing. Normal treatment processes, particularly activated sludge are instrumental in the control of infectious diseases, good for coliform contamination, but not for all pathogens. Bacteria, protozoa, fungi, viruses, molds and worms, do not collectively respond to present treatment concepts. Bacteria are virtually 99% eliminated by chlorination. Molds persist throughout activated sludge treatment plants and not much is known presently about fungi. Additional information is needed if reuse conditions are to be fully understood. Viruses, particularly that causing infectious hepatitis is of enteric origin and water-borne. Polio has not been proved to be water-borne but water treatment methods, flocculation sedimentation, filtration and chlorination have been shown to be effective. Cysts are present in sewage effluent and were demonstrated to have passed through the treatment facilities at Chanute, Kansas. Worms can get into water systems and do not respond to chlorination. Research is suggested in this area because it is believed worms could carry viruses into the water supply.

Chemical control is needed, exemplified by the ability of synthetic detergents to get through water and sewage treatment plants. Analyses for inorganic materials should be performed in water treatment plant laboratories. Toxic and carcinogenic compounds probably would not be removed in water treatment plants. Further work along these lines is indicated if true understanding of possible future problems is to be gained.

RADIOACTIVE MONITORING, by Dr. E. C. Tsivoglou of the Robert A Taft Engineering Center, Cincinnati, Ohio. Indiscriminate monitoring is not advised by the USPHS. The U. S. Bureau of standards Handbook 52 (1953) contains maximum permissible concentrations of radio-isotopes with regard to water supplies. Handbook 69 revises occupational figures and suggests by addendum a reduction by a factor of 10 for the maximum permissible concentration. Basic principles in determining the MPC is the protection afforded the effected body organ as opposed to the entire body. Daily regulation of radio-isotope intake is indicated since damage is a function of quantity of intake rather than concentration in miligrams per liter. Regulation of the total human exposure from water, food, air and daily occupation.

Water supply monitoring will point up the sources of contamination such as nuclear fallout (weapons testing) and manmade (municipal or industrial). Monitoring of water supply must be based on composite sampling to iron out local conditions such as rain and other atmospheric phenomena. Monitoring of raw and finished water is necessary to determine effective plant removal. Gross activity analysis will provide excellent screening following which results can be confirmed with a specific material analysis. Rainfall should be monitored to provide a key to the answers found by gross analysis and isolate this as a source of radioactive contamination.

Monitoring provides information with respect to trends in fallout and pollution and can be used as a basis to reassure the public when a question of radioactive contamination arises. Gross assay may cost $5.00 to $10.00 per sample whereas specific material analyses may run $15.00 to $20.00 per sample for radium and $20.00 to $40.00 per sample for strontium.

In determining the desireability of monitoring a water supply, it should be known whether or not any source of pollution can exist other than fallout. If so, monitoring of the supply should be instituted if local monitoring is not already being accomplished by a local water or milk network laboratory. It should also be determined whether the necessary funds and experienced testing personnel are or can be made available. Also a policy decision on whether data should be released or not must be made.

ELECTRONIC COMPUTERS IN THE WATER WORKS INDUSTRY, by Mr. R. S. Gooch, Freese, Nichols and Endress, Consulting Engineers, Fort Worth, Texas. Computers are enjoying increased satisfactory use in water works applications. Basically, computers are useful for any mathematical analysis or engineering computation. It can be assumed that the computer is good for solving significant problems rapidly and reliably and they can be operated by anyone who can understand the use of formulas and desk calculators. It is ad-

visable to ask help the first time in order to set up the problem and operate the equipment. Manufacturers and their representatives can provide manuals and technical assistance or specific courses may be taken under the auspices of the manufacturers. It is often more economical to use computers than to follow conventional methods, particularly if problems are those which must be solved repetitively. The use of the largest machine available to do the job required is recommended. This will provide experiences with all functions which are found separately in smaller machines. The decision as to whether a digital analog computer should be used depends on the nature of the problem. Where strictly number calculation is involved, the digital units are adequate while the analog devices are suited for parallel phenomena.

In deciding whether or not to use computers, an organization should determine whether or not a machine can be kept busy enough to own it and if a computer suitable to do the job is presently available. Equipment selection should follow substantial use and investigation of sizes and types of equipment available.

Sub-Division Water Extension Policies In Southwestern United States, by Mr. J. H. Teunisson, City Engineer, Greenville, Mississippi. Policies vary in nearly every municipality. Sub-dividers may construct the water extension, agreeing that the local utility will refund a percentage of the revenue each year until the sub-divider is reimbursed. Utilities may bear all the expenses provided the extension will serve sufficient customers to justify the expense and sub-divider may be required to extend water lines under strict design and specifications with no refund agreement. Examples of the use of these systems were given by Mr. Teunisson who concluded that a municipality is justified in requiring that all costs of water line extensions be borne entirely by the developer with the lines deeded to the city without compensation to the developer. City is justified in establishing rules for sub-divisions including approval of sub-division plats, installation of sanitary sewers, installation of storm sewers and construction of quality streets. While the private utility can adopt the same policies as the municipality, regulation should be provided keeping the private utilities initial investment to a minimum.

Water Supply Storage In Corps Of Engineers Projects As Effected By The Water Supply Act Of 1958, by Mr. F. O. Swiggart, U. S. Army Engineer Division, Dallas, Texas. The Act provides a general policy for considering water supply in civil works projects, including submission of new projects to Congress and modification of authorized projects to include water supply. Many reservoir projects have been authorized with specific provisions for municipal and industrial water supply, some of these have not been started, some are under construction and many have been completed. One of the major problems of the water supply act is, to what extent does it apply to previously authorized projects with specific water supply provisions? The Chief of Engineers has issued instructions that the water supply act of 1958 is applicable to all civil works reservior projects provided, however, previously authorized contracts executed under specific provisions may be modified only if water is not being delivered under the contract and that there is mutual consent to the modification.

Perhaps the most important expression of the new federal policy is the provision which authorizes the Corps of Engineers to include storage for *anticipated* future demand. This is important because it helps to develop each reservoir site as fully as possible. The act contains conditions and provisions applicable to this type of storage (for future use) must be limited to that for which the allocated cost does not exceed 30% of the total project cost; reasonable assurance must be obtained from state or local interests that contract for storage within the period of time which will permit paying out the allocated costs within the life of the project, but less than 50 years will be made; no payment for storage for future use need be made until such storage is first used; no interest shall be charged on such costs until such supply is first used, but in no case shall the interest-free period exceed 10 years.

Desalination Of Water Panel Discussion was led by Mr. J. J. Strobel, Office of Saline Water, Washington, D. C. Distillation processes were described as the oldest process inherently producing fresh water. Multiple effect distillation units reach a maximum practical limit with four or five effects. Scale problem has been predominant and the largest size currently in operation will produce one mgd. This method is not now competitive with currently available units. Flash distillation using multi-stage units operating under pressure utilize concentrate recirculation and improved scale techniques. Long tube once-through evaporators with short retention time also use concentrate recirculation in which magnesium hydroxide and sea water are used. A one mgd capacity unit is now under design. Vapor compression plants consisting of self-contained units compress steam in several cycles. Axial and centrifugal compressors are now being developed which should add efficiency to this type distillation process. Compressors may be driven by electricity or turbines.

Solar distillation requires unique equipment and depends on solar energy which provides intermittant, diffuse and low intensity energy. It has thus far not been economical to collect, store and to use solar energy though economics of the solar distillation process have been improved by design integration. A basin type distilling unit uses wicks, a transparent cover and includes a concentrate collector. The equipment is simple and low costs may be realized through the use of plastics. Active development programs under the sponsorship of the Office of Saline Water are underway at Daytona Beach, Florida where glass and plastic units are being operated. Units are also under test at Berkley, California, Algeria and Australia. While equipment is simple to operate and mechanically simple, information regarding costs has not yet been prepared.

Membrane processes have proved more suitable on brackish water than on sea water with the presently available equipment. Ion permeable and osmotic membranes have been extensively investigated. Membranes must have a high degree of permeability, low electrical resistance, be bacterially resistant, chemically resistant and offer little changes due to temperature. A number of satisfactory membranes are now available.

Pilot units have been operated in Arizona and South Dakota. Present activities include membrane life and durability tests being conducted at the Bureau of Reclamation Laboratories in Denver, Colo. and development of a laboratory test manual at Brooklyn Poly.

Freezing processes are among the older types of desalination methods. Procedure basically uses low salt solution temperature to separate salt from water as small crystals, 150 btu's per pound of water being required in the process. Two systems have been under development, indirect, based on heat exchange and a cold refrigerant flowing through coils, and direct freezing separation process. Latter has many advantages and can operate on pre-cooled sea water making large vapor volumes available. One direct freezing method uses lithium bromide absorption. A unit producing 15,000 gpm is now being tested for feasibility prior to shipment to a seaside location. Also, a process using hydro-carbon (isobutane) as refrigerant is now under test at Cornell University.

Disposal of waste concentrate streams from desalination plants in inland areas could be a problem. However, possible solution may lie in injection in underground strata or discharge to streams in tidal areas.

ANTIPOLLUTION LAWS AND THEIR ENFORCEMENT, were discussed by a panel representing the southwestern states. Alabama statutes were discussed by Mr. A. N. Beck, State Department of Health, Montgomery, Alabama. Earliest recommendations for pollution abatement were made in 1927 but the state was not ready to enact a law until the end of World War II when a conference was held to determine the needs. A report on all streams has been made and a bill drawn creating an advisory commission which meets annually in April and October. In 1949 the act was amended to give control over new pollution and pollution of streams causing public health nuisances. In 1953 the bill was clarified and extended to give stream use regulatory authority to the commission.

THE TEXAS POLLUTION REGULATIONS were outlined by Mr. G. R. Herzic, Texas Department of Health, Austin, Texas. Legal aspects of pollution in Texas were set up in 1913, personnel were not made available for enforcement until 1915, however. Legal action was difficult to enforce and public information and education has proved to be the best policy in order that favorable response and problem alleviation may be obtained. Laws have inefficiencies, but have been proved constitutional, therefore, changes are not under consideration. Streams in Texas have not been classified, but water use and type of pollutant is highly considered.

ARKANSAS APPROACH TO THE PROBLEM was described by Mr. G. T. Kellogg, Arkansas State Board of Health, Little Rock, Arkansas. Basic act relative to stream pollution was passed in 1949 and established a water pollution control commission. The act defined the terms, legal limits, duties and established penalty clauses. Enforcement provisions differ from other states, particularly in the aspect that no water less than drinking quality water leaves Arkansas. No stream classification has been done, each basin and stream are considered separately. Major pollutant is the oil industry where salt water injection is proving satisfactory.

LOUISIANA ACTIVITY was discussed by Mr. K. E. Biglane, Stream Control Commission, Baton Rouge, La. World War II also stimulated activity in La. when the stream control commission was given control of public and private waste disposal extending to all waters. Most of the water in La. is received from other states. The control commission does not take authority away from the State Department of Health in the execution of its duties. Louisiana's problems hinge on wet industries, oil field, gas wells, paper mills, refineries, naval stores plants, mining, petro-chemical, sugar mills, with the main difficulties coming from industries located in Louisiana for the longer period of time.

MISSISSIPPI ANTIPOLLUTION ENFORCEMENT was described by Mr. H. M. Jones, State Board of Health, Jackson, Mississippi. Two state agencies are charged with anti-pollution enforcement, the Board of Health established in the late 1800's and the State Game and Fish Authority established in 1946. There have been no instructions issued to classify streams in Mississippi. Control agencies can declare existance of nuisances and seek abatement voluntarily. Lack of voluntary action can be followed by court action to obtain compliance.

OKLAHOMA ENFORCEMENT LAWS were described by Mr. H. M. Crane, State Department of Health, Oklahoma City, Oklahoma. Enforcement authority is vested in the state Commissioner of Health. The Board of Health has the power to control materials added to streams. It can issue orders to cease pollution and classify the violation as a misdemeanor. Laboratories are operated to study streams and to support orders which have been issued. They also train operators to gather basic data. Oil and gas activities in Oklahoma are under the jurisdiction of the Corporation Commission.

ADEQUATE AND RELIABLE FIRE PROTECTION as related to the AWWA advancement program was described by Mr. K. J. Carl, National Board of Fire Underwriters, New York, New York. The first comprehensive municipal survey was made in 1904. Water works are analyzed thoroughly and compared with standard rating schedules, as revised in 1956. During the last 2½ years, 23 cities not previously surveyed have been reported by the National Board of Fire Underwriters. Also of 89 previously surveyed by the National Board, 42 had demonstrated improvement, 11 had maintained a status quo and 36 had retrogressed as result of little or no planning.

Two major factors with respect to fire protection a water supply affords are system adequacy and reliability. Most United States cities are growing and expanding their limits and should conduct flow tests to determine what is required to satisfy the demands of new areas. New arterial mains are frequently required rather than extensions of existing 6″-8″ mains. Mr. Carl proposed a rule of thumb measurement for hydrant spacing, namely every intersection or a maximum distance of 500 feet between hydrants. Shopping areas frequently having only one hydrant should have six or more to provide adequate coverage.

Of signifiance to those in sewage and industrial waste disposal design is . . .

Complete Mixing Activated Sludge

by ROSS E. McKINNEY,
Assoc. Prof. of Sanitary Engineering,
Mass. Inst. of Technology
Cambridge, Mass.

RESUME: One of the newest basic modifications for biological waste treatment is complete mixing activated sludge in which the wastes are intimately mixed with the entire contents of the aeration tank in a minimum of time. The two modifications of complete mixing systems are total oxidation and high sludge synthesis. The basic operations and design criteria for both modifications are discussed briefly. The most important advantage of complete mixing is its ability to take a waste of any BOD concentration and to produce an effluent of any desired BOD concentration in a single stage unit. Other advantages include the ability to absorb shock organic loads, to be unaffected by sludge hydraulic loads, to obtain maximum utilization of the air used, to produce little excess sludge or lots of excess sludge, to give a standard design for domestic sewage or industrial wastes regardless of the chemical nature of the wastes and lower capital costs than conventional activated sludge.

■ ONE OF THE most interesting modifications of the activated sludge process is complete mixing. It is not a new process but it has only been recently that the complete mixing concept has received the attention it has long deserved. The need for small treatment plants to handle domestic sewage from subdivisions and industries as well as strong industrial wastes has served as the impetus in the full development of the complete mixing process.

Complete Mixing

Complete mixing is a basic process in which the incoming wastes are completely mixed with the entire contents of the aeration tank. There are many different modifications of the basic process involving endogenous respiration with combination aeration-sedimentation units or separate aeration tanks and sedimentation tanks and varying rates of synthesis. All of these modifications fall within the general concepts of the basic process thus greatly simplifying the engineering and operations.

In order to obtain complete mixing in the aeration tank it is necessary to introduce the incoming wastes into a relatively small tank volume with violent agitation so that the time for complete dispersion is a minimum. Normally, the agitation is supplied by aeration. In small tanks the wastes can be introduced at a single point but in large tanks multiple inlets will be required.

The key to complete mixing is the fact that the aeration tank acts as a surge tank and tends to level out the wide fluctuations in the organic load. The use of the entire mass of the activated sludge to stabilize the organic load distributes the load uniformly over the entire aeration tank and permits better utilization of the air blown ino the mixed liquor.

Effluent Quality

The desired effluent quality determines the size of the complete mixing system. It is possible to produce an effluent of any desired organic level from wastes of any organic strength. An effluent of 15 mg/1 BOD can be produced from wastes having 100, 1000 or even 10,000 mg/1 BOD. This high quality effluent can be produced in a system with minimum excess sludge production or with a large excess sludge production.

The effluent BOD is made up of two components, the soluble BOD and the suspended BOD. The soluble BOD is a function of the total organic load within certain ranges of mixed liquor suspended solids (MLSS) concentrations. The suspended BOD is a function of the sedimentation tank efficiency.

Microbial Activity

The stabilization of organic matter in any biological waste treatment system is brought about by the biochemical activities of the microorganisms in the system. Thus the bacteria are primarily responsible for the stabilization of the organic matter in activated sludge systems. It has been shown that the bacteria remove organic matter from wastes in order that they might obtain sufficient en-

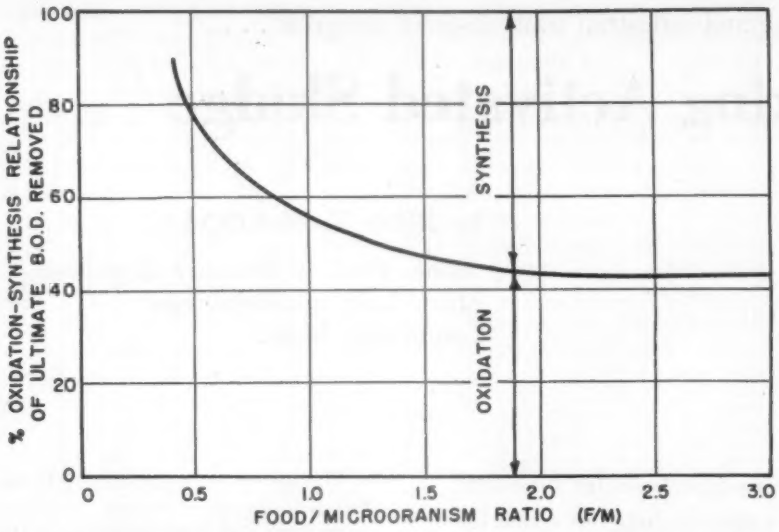


FIG. 1. THE RELATIONSHIP between the food: microorganism ratio and the synthesis-oxidation relationship

ergy to remain alive, to produce new cells and to obtain the chemical components for the new cells. The wastes must supply both the energy and the building blocks for these new cells. A deficiency in either element will result in reduced microbial activity and hence reduced stabilization. For the purpose of this paper it is assumed that the wastes are all nutritionally balanced.

One of the most important aspects of biological metabolism is that there is a definite quantitative relationship between the organic protoplasm produced and the energy expended in its production together with the organic matter removed from solution. If a few bacteria were placed into a rich nutrient solution, the bacteria would begin to grow at a rapid rate. If the mathematical function of growth were determined, it would be found to approach a log growth rate. The bacteria growth is limited only by the microorganisms ability to reproduce. Food is definitely unlimited. Examination of the growth of bacteria in the log growth rate has shown that the bacteria convert approximately 67 per cent of the ultimate BOD removed into protoplasm while oxidizing 33 per cent of the ultimate BOD removed to obtain the energy for the synthesis reactions.

A point is eventually reached where the demands of the active microorganisms exceed the food available and growth becomes limited by the lack of food. The rate of growth is proportional to the available food per unit of microorganisms. This can best be expressed as a food: micro organism ratio (F:M). Data on pure cultures has shown that log growth rate ceases when the F:M ratio drops below 5.0. As the F:M ratio decreases, a point is eventually reached where there is just enough food present to keep the microorganisms alive without the production of additional protoplasm. This is the so-called endogenous metabolism. A further drop in food level results in autodigestion of the protoplasm to furnish the necessary energy. Thus, a drop in food gives a corresponding drop in microorganisms. The F:M ratio actually remains constant at 0.45

It is immediately apparent that the rate of excess sludge production in the complete mixing system will be dependent upon the F:M ratio. A high F:M ratio will result in a large excess sludge problem while a low F:M ratio will result in a minimum of excess sludge. A plot of the oxidation-synthesis relationships for varying F:M ratios is shown in Fig 1. One of the most important aspects of this diagram is the fact that the synthesis drops from a maximum at log growth to a minimum at endogenous metabolism. It can be seen that there is some synthesis in endogenous metabolism even though there should be no synthesis. The synthesis of active protoplasm reaches zero in the endogenous phase but there is the production of an inert polysaccharide material which builds up mass in the sludge without affecting the biological activity. The production of the inert polysaccharide is the reason why it is theoretically impossible to have an activated sludge system operating in endogenous metabolism with no sludge build-up. All so-called complete oxidation systems result in some build-up of inert organic matter which must either be removed or discharged in the effluent.

Flocculation

In order for an activated sludge system to operate continuously at any level of efficiency, it is necessary for the sludge to flocculate well and to settle quickly in the sedimentation tank. In most biological treatment systems the effluent BOD is directly related to the efficiency of the final sedimentation tank. Good suspended solids removals will produce effluents of low BOD.

It has been shown in previous research that flocculation of activated sludge is related to the energy level of the microorganisms as they enter the sedimentation tank. A high residual organic level will result in poor flocculation and hence poor sedimentation. On the other hand, a low residual organic level will yield good flocculation and a clear effluent with efficient sedimentation. When activated sludge is young and growing rapidly, flocculation is related to the F:M ratio. Bacteria in the log growth phase will not flocculate or settle but as the F:M ratio decreases, flocculation increases until complete flocculation occurs in the endogenous phase. Once activated sludge has formed, there is a residual of inert floc which acts as a flocculating agent even though the F:M ratio might rise to 4 or 5. Flocculation is related at these high F:M ratios to the actual organic concentration surrounding the dispersed microorganisms. A BOD level of 10 mg/1 will produce good flocculation regardless of the F:M ratio as long as the MLSS concentration exceeds 500 mg/1. As the BOD level rises to 25 mg/1, bacterial dispersion increases slightly above normal. A BOD of 50 mg/1 will cause the effluent suspended solids to rise to 50 mg/1 regardless of the sedimentation tank efficiency. A BOD of 100 mg/1 will yield an effluent with between 100 and 150 mg/1 suspended solids.

Total Oxidation

Most sedimentation tanks will yield effluents containing between 20 and 25 mg/l volatile suspended solids when operating at maximum efficiency. With the total oxidation modification of the complete mixing process loss of 10 to 25 mg/l solids is very important in the solids control. Operation of the complete oxidation systems in the endogenous phase yields a sludge growth of approximately 11 per cent of the 5 day BOD removed. An effluent with 25 mg/l suspended solids would be in equilibrium if 240 mg/l 5 day BOD were being removed from the wastes. A waste with less than 240 mg/l 5 day BOD would lose solids until the F:M ratio increased to the point where synthesis equaled the solids being lost. A waste with more than 240 mg/l would yield an increase in solids greater than that being lost in the effluent. Eventually, such a system would fill up completely with sludge and the effluent suspended solids would increase unless solids were removed from the aeration tank.

The addition of inert suspended solids such as occur in domestic sewage and some industrial wastes will have a definite effect on the solids balance. If 25 mg/l or more inert volatile organic suspended solids are added in the influent, these inert solids must either be discharged in the effluent or removed from the aeration tank at periodic intervals.

One of the prime bases for design of complete mixing activated sludge systems operating on the total oxidation principle has been 24 hours' aeration. The use of 24 hours' aeration is not a rational design concept anymore than 20 hours' aeration or 40 hours' aeration. Design of total oxidation units should be related to the strength of the wastes and not to an arbitrary aeration period. Total oxidation units preclude that the system will be operating in the endogenous phase which means an F:M ratio of 0.45. For any F loading, M is automatically determined. If the wastes contain 250 mg/l 5 day BOD the MLSS would be 810 mg/l if the aeration period were 24 hours; 1620 mg/l with 12 hours' aeration; 3240 mg/l with 6 hours and 6480 mg/l with 3 hours' aeration. It can be seen that the organic loading in terms of pounds 5 day BOD/1000 cu ft aeration capacity/day would be 15, 30, 60 and 120 respectively. It appears possible to maintain a system in endogenous metabolism as long as the organic load does not exceed 40 pounds 5 day BOD/1000 cu ft/day. At this loading it would be necessary to maintain 2160 mg/l active MLSS which would require a system capable of handling apporximately 3200 mg/l total MLSS. The effluent from such a system would contain approximately 9.0 pounds volatile solids/1000 cu ft aeration capacity/day. If the wastes were retained for 24 hours, the influent would have contained 670 mg/l 5 day BOD and the effluent would have contained 150 mg/l volatile suspended solids. A 12 hour retention period at 40 pounds loading would have had 335 mg/l 5 day BOD and an effluent with 75 mg/l volatile suspended solids. A 6 hour aeration period would have an influent BOD of 168 mg/l and an effluent with 38 mg/l volatile suspended solids. The 5 day BOD of the effluent from these units would be approximately 52, 26, 13 and 7 mg/l respectively.

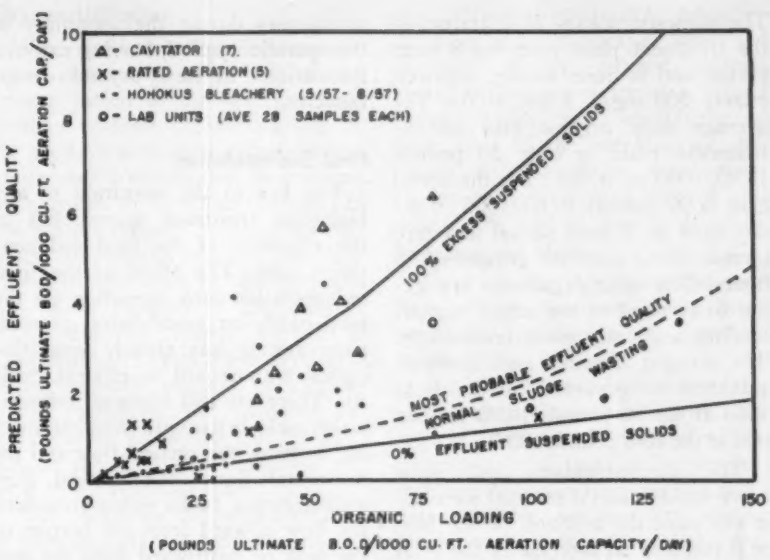


FIG. 2. PREDICTED EFFLUENT QUALITY at various organic loadings of several complete mixing activated sludge systems

If the wastes had a 5 day BOD of 168 mg/l and were treated for 24 hours in the aeration tank instead of 6 hours' aeration as in the previous section, the organic loading would be 10 pounds 5 day BOD/1000 cu ft /day. The effluent would contain 1.8 pounds volatile suspended solids which would yield a concentration of 30 mg/l and a 5 day BOD of 13 mg/l. It is immediately obvious that the effluent quality for 6 hours' aeration is only slightly higher than for 24 hours' aeration. A system designed on the basis of 24 hours' aeration would in effect be overdesigned by 18 hours.

Intermittent Flow

The previous analyses were made on the basis that the wastes were added continuously 24 hours a day, 7 days a week. Many waste flows are not continuous and often the organic load is not uniform. With industrial wastes it is often possible to discharge the wastes to a surge tank and to feed the waste treatment plant at a uniform rate on a continuous basis. With domestic sewage from small industrial buildings, motels, etc., it is possible to add an aerated surge tank ahead of the aeration unit to level out waste flows and waste strength. Economics determine the validity of surge tanks to reduce the size of the treatment plant.

If it is not possible to have uniform flow, the treatment plant must be designed on the basis of the load arriving and not on the average daily load. Because of the complete mixing systems leveling action it is possible to make the design of the basis of the maximum hourly load. Consider an industrial building operating on a single 8 hour shift, 6 days a week.

The domestic sewage flow arrives at the treatment plant over the 8 hour period and is quite strong, approximately 500 mg/1 5 day BOD. The average daily organic load on the treatment plant is only 30 pounds BOD/1000 cu ft/day; but the actual load is 90 pounds BOD/1000 cu ft/day over an 8 hour period and zero pounds BOD over the remaining 16 hours. The microorganisms are going to respond to the actual organic loading and will grow accordingly. The oxygen demand and synthesis rate will be governed by the F:M ratio at the 90 pounds BOD loading and at the zero pounds BOD.

The microorganisms will grow more rapidly than if the load were uniform since the addition of the food will result in an increase in the F:M ratio. The system will attempt to reestablish equilibrium but will not be able to do so since the food suddenly stops and starvation sets in for the 16 hours without food. The microorganisms will undergo endogenous respiration and decrease in active mass for the 16 hours until the organic load starts again. One of the most important facts about endogenous metabolism is that cells fed continuously in the endogenous phase will produce less excess sludge than cells which are fed the same amount of food in a slug and allowed to starve for the same period. The net result is that the feed-starve cycle of intermittent operations results in more sludge for ultimate disposal than the continuously fed system. This is most important in any design.

The effluent BOD concentration from the intermittent system and the continously fed system will be quite close on an average value. Anyone wanting to show better operations of the intermittently fed system can do so by the use of grab samples of the influent and effluent just after the wastes have started into the plant at the start of a feed cycle. The effluent will be at a minimum since the microorganisms have had 16 hours to utilize all of the available food and the influent strength will be a maximum. Control authorities should always take their grab samples at the end of the feed cycle when the effluent quality is poorest. If the effluent quality is satisfactory at the end of the feed cycle, it can be certain that the effluent quality was satisfactory during the remainder of the operation period, barring extreme fluctuations in flow beyond design capacity.

Final Sedimentation

The key to the operation of any biological treatment system lies in the efficiency of the final sedimentation tank. The effect of the final sedimentation tank operation on the total oxidation modification of complete mixing has already been discussed with regard to effluent quality. There are two types of sedimentation tanks in use with complete mixing systems, the vertical flow and the horizontal flow. The vertical flow sedimentation tanks either introduce the flow upward from the bottom of the tank or downward from the top. In both cases the velocity of the flow into the tank is the most important factor in the design of the sedimentation tank. The upward flow tank has been used primarily where the aeration tank and the sedimentation tank are built into a single unit. The upward flow tank must have a sufficiently high flow rate to keep the contents of the sedimentation tank always turning over but not great enough to carry the sludge over the weir. The shape of the sedimentation tank controls the hydraulic patterns as does the turbulance created by the aeration device. Generally speaking, the hydraulic overflow rate should be approximately 500 gal/sq ft/day. With intermittent flows provision must be made to return the sludge to the aeration tank to prevent septicity. If the sludge in the sedimentation tank should become septic, denitrification could result with nitrogen gas lifting the sludge to the tank surface. The sludge carried to the sedimentation tank surface becomes quite concentrated and can create a definite nuisance by either going out in the effluent or producing obnoxious odors.

The downward flow sedimentation tank must have an overflow rate below 500 gal/sq ft/day in tanks with a water depth of 8 ft or less and below 800 gal/sq ft/day in deeper tanks. The reason for the variation in flow rates lies in the fact that the flow of the mixed liquor entering the tanks will disturb the sludge which is being concentrated and removed just below the point of introduction of the mixed liquor. All of the downward flow sedimentation tanks use continuous return of sludge with either air lift or motor driven pumps. The rate of return must be great enough to handle the sludge as quickly as it settles. With total oxidation systems the MLSS concentrations reach 6000 mg/1 which requires sludge return rates of from 100 to 200 per cent of the waste flow. With the high rate of sludge return care must be taken to use the hydraulic energy to help concentrate the sludge.

Horizontal flow tanks do not have as much turbulence due to the introduction of the mixed liquor and can be designed with hydraulic overflow rates up to 800 gal/sq ft/day. With high flow rates density currents can be a problem and care should be exercised in design.

High Synthesis

Although most of the use of complete mixing has been with the total oxidation modification, it is well suited to high sludge synthesis. For a given food loading, synthesis can be stimulated merely by reducing the MLSS concentration. For wastes with low BOD concentrations it is possible to convert half of the organic matter into sludge and still produce a satisfactory effluent. The advantages of high synthesis of sludge are a smaller treatment plant and lower air requirements; while the disadvantages include excess sludge disposal facilities and more complex operations. With small treatment plants the economics favor the total oxidation units while in large treatment plants the economics are in favor of high synthesis units.

Inert Solids

It has already been indicated that inert solids in the wastes will have an adverse effect on total oxidation systems. Generally speaking, the total oxidation systems take the entire waste flow into the aeration tank, eliminating primary sedimentation tanks and anaerobic digestion. A portion of the organic matter added to the aeration system in the form of suspended solids is inert to biological degradation. These inert suspended solids are incorporated into the activated sludge and become part of the MLSS. Unless the inert solids are discharged from the aeration tank,

they will build up in the MLSS causing much of the MLSS to become inert solids rather than active solids. The system will eventually fill up with sludge and discharge it in the effluent. When the excess solids are discharged in the effluent, a portion of the suspended solids discharged will be active cells. This results in an increased F:M ratio and increased sludge synthesis. The net result in a total oxidation system is that instead of converting 11 per cent of the BOD removed into sludge, 30 to 50 per cent of the BOD is being converted into sludge. The system breaks down as far as total oxidation is concerned and becomes a high synthesis system. The only way that the system can be maintained as a total oxidation unit is to periodically remove most of the MLSS and to start anew. An example is that if the aeration tank contains 10,000 mg/l MLSS when the system is full of sludge, the MLSS should be reduced at least 90 per cent to 1000 mg/l to insure removal of most of the inert solids. The active mass will quickly build back to equilibrium and then the tank will slowly fill with solids. The rate of sludge removal will be a function of the inert solids concentration. Since the sludge is predominately inert solids, it will dewater directly on sand drying beds and will not require further treatment.

Oxygen Utilization

The complete mixing system obtains maximum utilization of the oxygen added to the aeration tank. With a uniform organic loading on the aeration tank, the oxygen demand in the entire system will be constant as a result of complete mixing. In the total oxidation systems the demand for oxygen is very low. Sufficient oxygen must be added to meet the entire demand of the ultimate BOD removed. The ultimate BOD is normally 1.5 times the 5 day BOD. Since a small fraction of the organic matter is not oxidized but winds up in solids, the calculation of air on the total BOD removal will give 10 per cent excess air.

The efficiency of oxygen transfer is very important in complete mixing systems since the power requirements and hence the cost of operations are largely related to this factor. In total oxidation systems the demand for oxygen seldom exceeds 40 mg/l/hour. At this air rate most diffused aeration devices will not yield more than 5 per cent oxygen transfer efficiency. It has been found that steel pipe with drilled holes will yield 5 per cent efficiencies in complete mixing systems and will perform as well as any proprietary air diffusion devices.

With the high synthesis systems the demand for oxygen increases quite sharply. The proprietary oxygen diffusion equipment definitely show up at an advantage when the increased oxygen demand permits higher efficiencies of transfer. Up to oxygen demand rates of 100 mg/l/hour most of the non-clog air diffusion devices will be satisfactory. Higher rates of oxygen demand will require the use of turbine aerators.

Prefabricated Units

There are many prefabricated complete mixing treatment plants being marketed by equipment manufacturers.

The prefabricated treatment plants give results consistent with the criteria cited for the design of the complete mixing units in the previous sections. Although there are not much data available on complete mixing plants in the field, some of the data which are available are shown in Fig 2. It can be seen that the actual field results are consistent with the design criteria already cited. Studies are currently being conducted on several complete mixing plants treating domestic sewage and industrial wastes to determine the operational characteristics of these plants so that the design criteria can be fully evaluated. The data which has been obtained to date are consistent with the concepts of design given in previous sections. Cost figures indicate a capital cost and operational costs 25 to 50 per cent below that of conventional activated sludge treatment.

Industrial Water Conservation

The University of Michigan has published a compilation of the papers presented at the Short Course on Industrial Water Conservation in Ann Arbor, June 1959. The publication is intended to be not only a record of what transpired, but is, in general, a handbook or guide for future studies.

Among the topics discussed and explored are: Where does water come from and how much is there; The need for water conservation from the viewpoint of industry; elements of water management; conducting a plant survey; site selection; and the water conservation efforts of various industries such as food processing, chemical, automotive, paper, steel and oil.

The 115-page book is distributed by the University of Michigan, School of Public Health, Continued Education Series, 109 S. Observatory St., Ann Arbor, Michigan. The book is priced at $3.00 a copy.

Water and Sewage Bond Sales Data

The Public Health Service has recently been compiling and developing water and sewage bond data as an adjunct to program responsibilities in these fields. Since these data were analyzed by machine punch card methods, it has been convenient for the Service to prepare certain tables which were felt to be useful to others concerned with this problem.

Some of these tables have been brought together in a small document entitled, "Water and Sewage Bond Sales in the United States, July 1956-June 1959". The Service expects to continue assembling data of this type on a monthly basis, and will probably compile it periodically for whatever use and interest it may find outside of the Service itself.

Ultra-Modern Station for Chicago's Southwest Side

The City of Chicago will place an ultra-modern water pumping station in operation on its southwest side, which will serve some 250,000 users in the city and eleven suburbs. The new station, expected to be completed by April, 1961, will have an initial capacity of 175,000,000 gallons per day, but will be boosted to 275,000,000 gallons per day when the demand increases.

The plant will be 151 feet long, 120 feet wide and will be built without deep and costly pump pits. These will be eliminated through the use of a new kind of water pump which has a long shaft that will reach down to the water level. Known as the vertical, submerged-type, turbine pump, it has been successfully used by Kansas City and the Atomic Energy Commission.

Unique Recirculation Control System is a feature of the new . . .

Reidsville, N. C. Trickling Filter Plant

by E. J. MOGLNICKI, Piatt & Davis and Associates, Consulting Engineers

EDITOR'S NOTE: Automatic control of recirculation in a new 3.0mgd. trickling filter plant is based on sump level. This report also describes system modernization to meet stream classification standards.

Reidsville, N. C. was faced with a major problem in 1953, when it became necessary to treat its wastes so that the receiving streams would meet proposed classification standards of the North Carolina State Stream Sanitation Committee. The City voluntarily took steps to meet its obligations with regard to the proposed classifications.

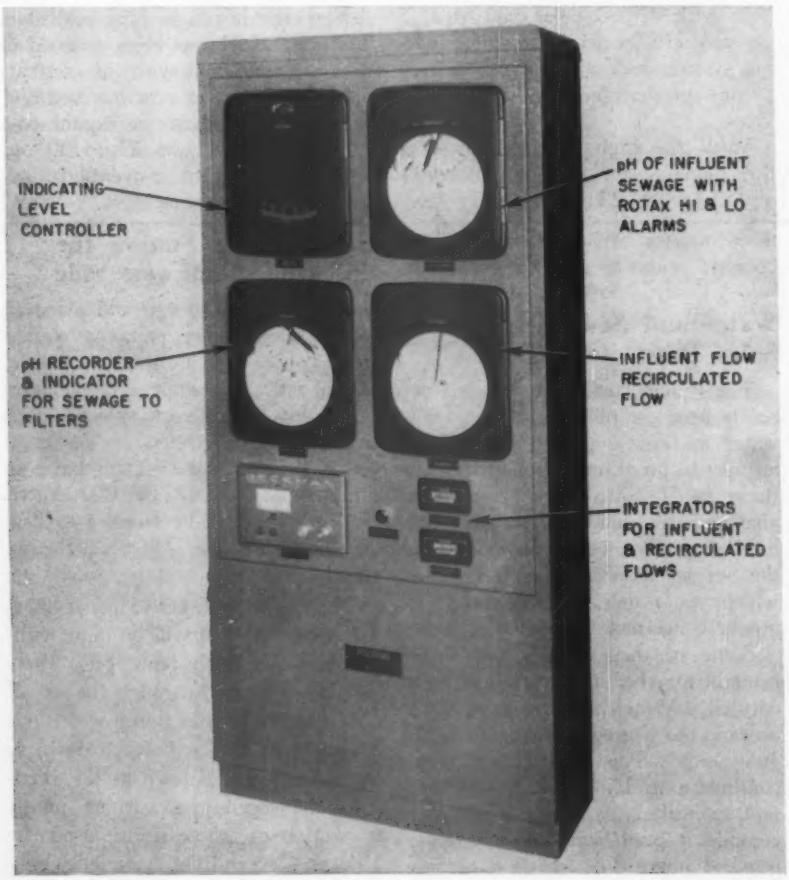

INDICATING LEVEL CONTROLLER
pH OF INFLUENT SEWAGE WITH ROTAX HI & LO ALARMS
pH RECORDER & INDICATOR FOR SEWAGE TO FILTERS
INFLUENT FLOW RECIRCULATED FLOW
INTEGRATORS FOR INFLUENT & RECIRCULATED FLOWS

FIG. 1. CENTRAL Control Building Main Panel

Piatt & Davis and Associates were retained to investigate the problem and to make recommendations for improvements which would not only meet State Stream Sanitation Committee requirements for existing conditions, but would provide adequate sewage collection and treatment facilities for encouraging industrial expansion.

Solution to the problem called for extensive construction of new, and repairs to existing, facilities. Reidsville is located on a ridge between the Dan-Roanoke and Haw-Cape Fear River Basins and has topography such that use of several pumping stations was mandatory. The existing sewage collection and treatment systems, consisting of three treatment plants and four pumping stations, had become obsolete and overloaded. Approximately 60 percent of the total wastes tributary to the collection system flowed to a grossly overloaded septic tank which provided practically no effective treatment. Lacking facilities to adequately treat wastes from the City's largest water user alone, the American Tobacco Company, City officials were hardly in a position to promote advantages of location in Reidsville to other water using industries.

Engineer's recommendations resulted in a $1,150,000 sewage collection system and treatment plant improvement program, which took three years to complete. The key to the program was a new 3.0 MGD High Rate Trickling Filter Plant, which was put into service in 1957, five years ahead of the Stream Sanitation Committee schedule. Other construction included three pump stations, improvements to an existing pump station, and necessary outfalls, inter-

ceptors and force mains. Built-up areas of Reidsville are now almost completely sewered, and the City is in an excellent position, as far as water supply and waste treatment are concerned, to promote expansion.

Treatment facilities provided were designed to meet present and expected demands, with an eye on simplifying daily operation by the efficient use of instrumentation. Included are a bar screen, grit chamber, primary sedimentation tanks, high rate filters, final settling tanks, chlorine feed equipment and contact tanks, sludge conditioning tanks, digesters and sludge drying beds. Recirculation to the filters is from the effluent end of the final sedimentation tanks.

Instrumentation is centered in two Foxboro control panels: a main panel (Figure 1), located in the Central Control Building, containing instruments pertinent to overall plant operation; and a second panel (Figure 2), located in the Digester Control Room, containing instruments useful in successful digester operation.

Incoming sewage, after screening, passes through a Parshall flume where the rate of flow is measured by a float and cable type instrument which transmits the rate of flow signal pneumatically to a two-pen recorder located in the lower right-hand side of the main instrument panel. The second signal to this instrument is similarly transmitted from a Parshall flume measuring the rate of flow of recirculation to the filters. Integrators, feeding counters located below the recorder, provide running totals of the quantity of both plant influent and recirculation.

From the influent Parshall flume, sewage flows through the grit chamber to three reinforced concrete primary sedimentation tanks, each of which provides approximately two hours detention at a rate of flow of 1 MGD. Settled sewage flows by gravity to a wet well, located under the ground floor of the Central Control Building, from which it is pumped, together with recirculated final sedimentation tank effluent, to the filters.

Generally, in plants of this type, the rate of flow of the recirculation to the wet well is controlled by a ratio control arrangement at a varying rate which is some preselected percentage of the plant influent flow. Pump speed or capacity must then be regulated either automatically or manually to keep pace with the flow into the wet well. In such a system, means must be provided to vary the ratio between plant influent and recirculation so that pumping to the filters can be maintained, even during periods of low plant influent flow, at rates high enough for satisfactory filter performance.

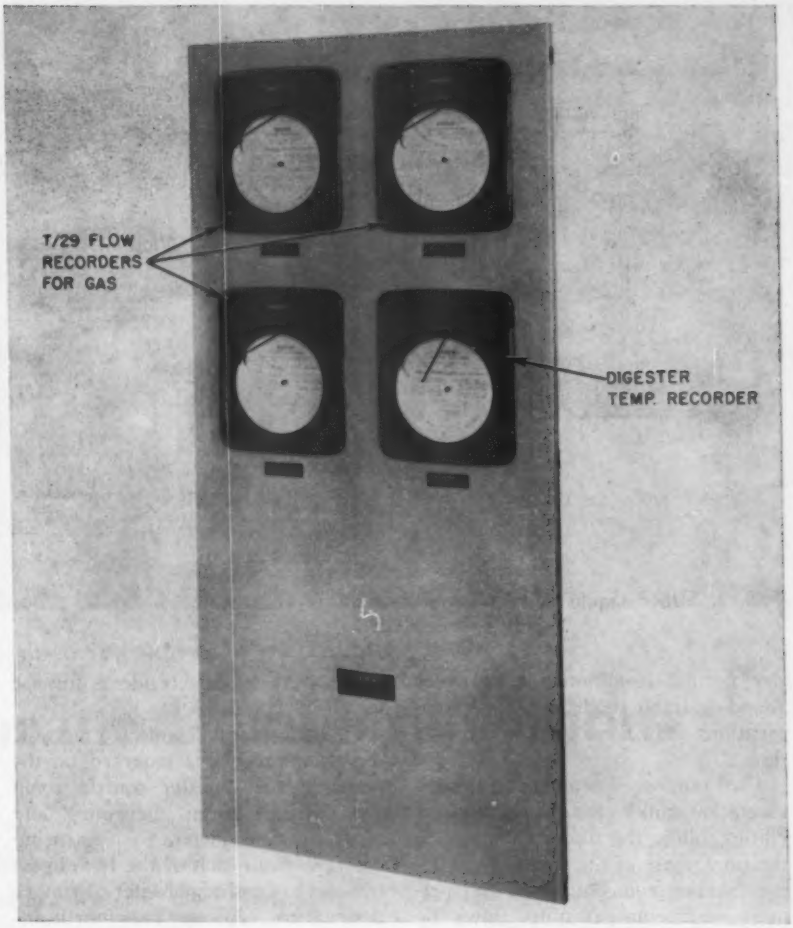


FIG. 2. DIGESTER Control Room Panel

At Reidsville, it was decided that control of recirculation based on sump level rather than plant influent rate of flow (Figure 3), would provide a more simple and economical arrangement. Such control was provided by use of a Foxboro Stabilog indicating level controller (instrument at upper left of panel). The controller, together with a bubble tube measuring element, keeps sump level at a set point by operating an 18-inch butterfly valve in the recirculation line from the final sedimentation tanks. Any lowering of sump level causes the control valve to open to the degree necessary to maintain the set level. Conversely, a rise in sump level causes the control valve to close to the required degree. Careful selection of the three low lift pumps enables the plant operator to choose at any time a combination of pumps which will provide, within reasonable limits, the recirculation ratio desired for the required treatment. The dual pen flow instrument provides a continuous comparison and record of plant influent and recirculation rates, and the level controller provides continuous indication of sump level and valve position. With this information and the pH records (plant influent pH recorder in upper right of panel and filter feed pH recorder in lower left of panel), the operator is kept fully informed of overall plant operation. He can instantly detect shock loadings of industrial wastes of abnormal pH and alter his recirculation ratio accordingly. As a further aid, the plant influent pH instrument is equipped with electrical contacts which energize a horn to warn of excessively high or low influent pH. Un-

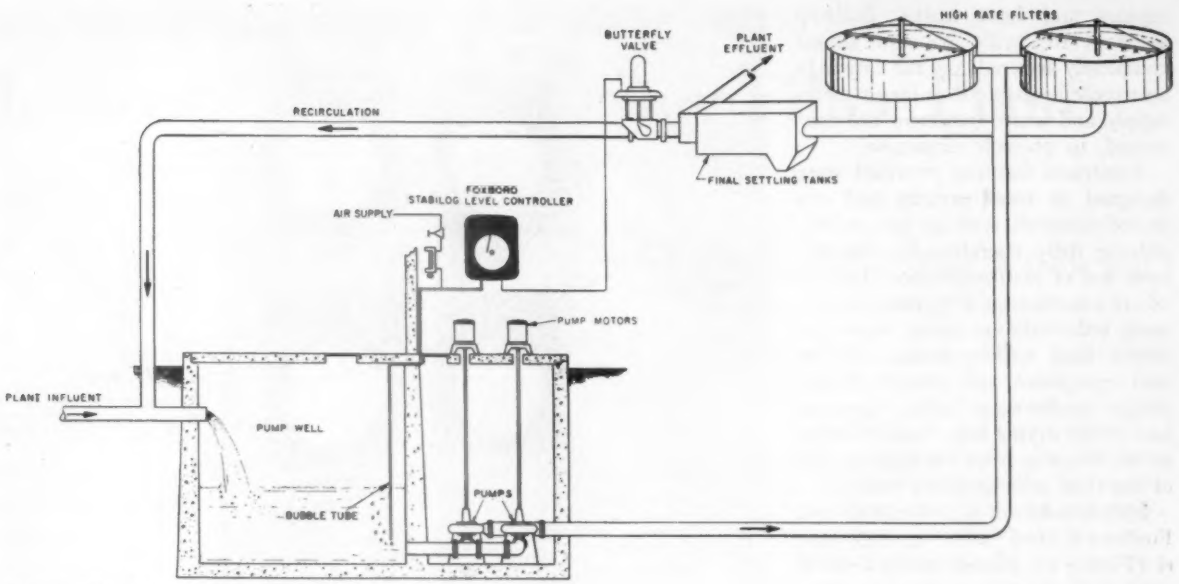


FIG. 3. SUMP Liquid Level Control System

der normal conditions, it has been found desirable to change pump combinations only three or four times a day.

Five reinforced concrete final sedimentation tanks and chlorination facilities follow the filters and provide the final phase of the treatment process. Sludge from both final and primary sedimentation units flows by gravity to sludge conditioning tanks where facilities are available for aerating, mixing, and thickening. Conditioned sludge is then pumped to two digesters for final treatment prior to drying on sand beds. Dried sludge is given away to area residents for use as a soil conditioner.

Instrumentation connected with the digestion process is mounted on the panel in the digester control room and includes three integrating and recording flow meters for measuring gas flow from each of the two digesters and to the sludge heater. Primary devices are orifices. The fourth instrument on the panel records temperatures in each of the digesters.

Additional instrumentation involved in the overall improvement program includes Foxboro Rotax Controllers for operating pumps automatically, from wet well levels, at three of the pumping stations in the collection system. A fourth new station is planned for construction in the near future, using similar controls.

In the two years during which the plant has been in operation, there has been every evidence that modern instrumentation has contributed substantially to the ease of operation with a minimum of maintenance. Instrumentation has furnished the operators with complete and continuous information on the major variables involved, and automatic controls have been efficient and reliable.

Improvements Proposed for Ohio River Valley

At a recent meeting in Cincinnati of the Ohio Valley Improvement Association, Lt. General E. C. Itschner declared that it would cost at least 4 billion dollars to develop adequate flood control, navigation and water supply systems in the Ohio River Valley.

"Our present 1,650 mile Ohio River navigation system," he stated, "is now inadequate for the efficient transportation of the unprecedented increase in waterway traffic. Increased activities will obviously call for a considerably higher rate of water resources development."

Observing that the construction of modern locks and dams has already been started along more than a third of the waterway, he asserted that "the flood control program must go forward at a pace equal to that of navigation."

To help the Federal government develop the river's potential as a water supply and prevent damaging floods, General Itschner urged that state and local government undertake a three-fold action. First, they should act so that dual highways, airports and utility lines, and other public facilities, are not built in areas planned to be future reservoirs.

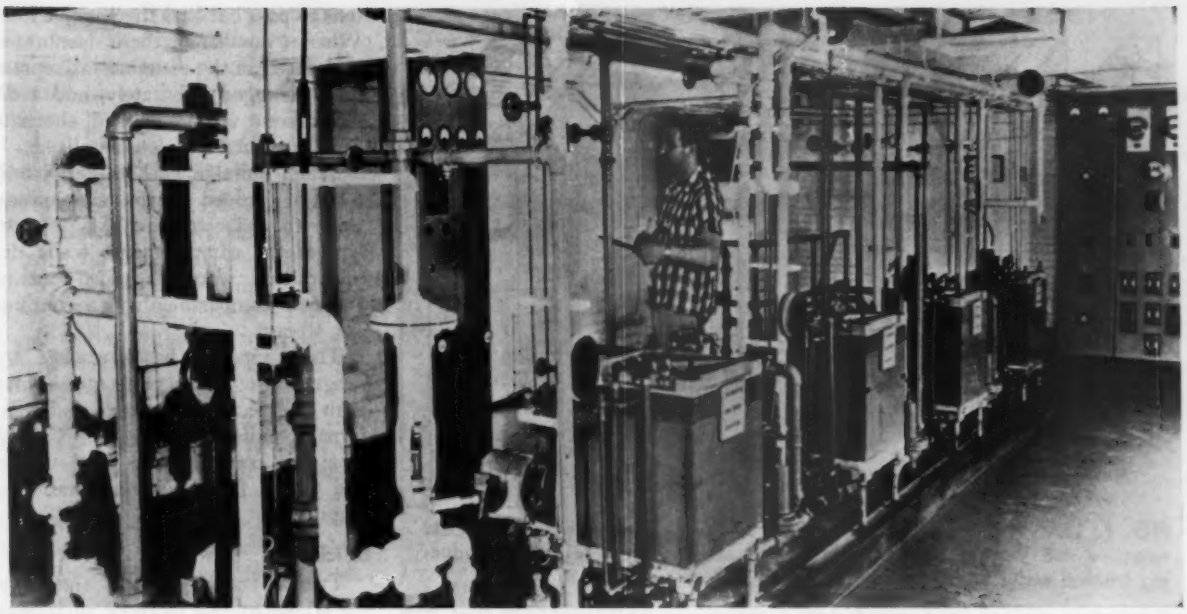
Another responsibility that local governments should meet is to forbid building in areas periodically flooded. This would eliminate the necessity for expensive flood walls and other flood control edifices.

Finally, he urged that municipalities combine their local water supplies with those of the Corps of Engineers so that flood control and water supplies could be obtained at reduced costs.

Engineering Lecture Program

The Engineers Joint Council has submitted a request to the National Science Foundation for funds to initiate a visiting engineers lecture program. Their intention is to invite outstanding engineers from abroad who would present lectures at various educational centers for students, faculties and engineers in the area.

The specific programs would be developed and sponsored by various engineering societies, with the overall coordination by the EJC.



Equipment removes 700 mg/L dissolved solids by electrolytic . . .

Porous Membrane Demineralization

RESUME: The treatment of sea or brackish waters to obtain fresh water may be more economical in many areas than transporting water by tank car or pipeline. Water consumption and the amount of solids removal required are the major factors in determining the economy of treatment.

The continuous porous membrane electric dimineralizing process offers distinct advantages to municipalities with brackish water problems. Nickel alloys employed in equipment manufacture reduces corrosion problems associated with handling saline waters thus reducing equipment operating costs. These improvements plus others serve to reduce the cost of treated water for the consumer.

■ NATURAL SOURCES of fresh water are rapidly becoming insufficient to meet the demands of expanding populations and increasing industrialization. Engineers and scientists all over the world are searching for economical methods of turning sea or brackish water into fresh potable water. Among them is the manufacturing firm of Ionics, Inc., a Cambridge, Massachusetts firm, that has developed a porous membrane electric method of desalting brackish water to a useful level at a low operating cost. This method may offer distinct advantages for municipalities where there is a choice between a local mineralized supply and a more remote fresh water supply.

Electric membrane demineralizers are capable of removing a major portion of the dissolved cations (sodium, calcium and magnesium) and anions (chlorides, bicarbonates and sulfates) which contribute to hardness and alkalinity in natural waters. These undesirable characteristics must be removed in order to provide potable water for household and industrial use.

Example Installation

Cheap water by the demineralizers may enable communities to grow under conditions which would otherwise limit them. The electric membrane process provides an advantage in that it leaves dissolved air and some solids in the water, thereby giving a fresh taste rather than the flat taste usually associated with distilled water.

A membrane demineralizing plant has just commenced supplying 28,000 gpd of drinking and cooking water for the 6,000 citizens of Coalinga, California. A 2.5-month test of a demonstration demineralizer unit in the Spring of 1958 showed that the method could produce potable water at a cost of about $1.14 per 1,000 gal. It is estimated by the town's director of public works that a full-scale plant could demineralize its brackish well water from an average 2,000 mg/L to a maximum of 300 mg/L at a cost of $1.00 per 1,000 gal. This is only one-seventh the cost it now has to pay for water hauled 45 miles by railroad.

Coalinga has two water systems. The untreated water is used for irrigation and billed at a flat rate, while the drinking water is metered and piped separately to consumer. The demineralized water produced during

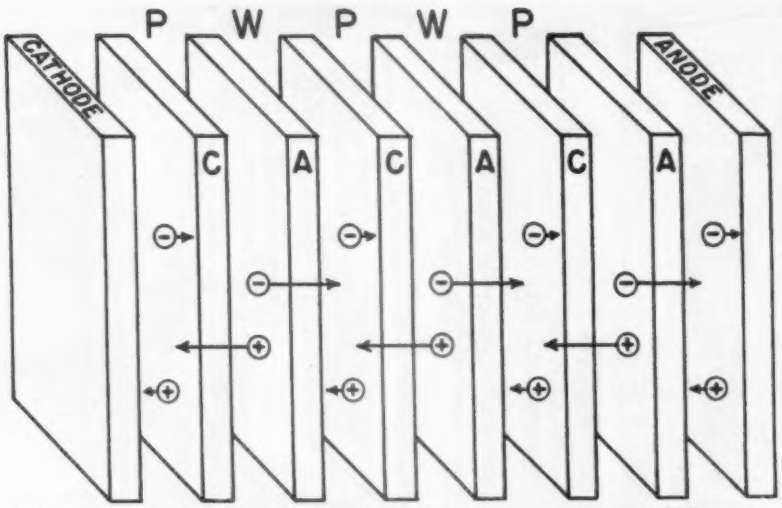


FIG. 1. STANDARD STACK ASSEMBLY, A and C—membranes which pass negative and positive ions, respectively, P and W—compartments producing treated water and waste, respectively.

the test is said to have tasted very similar to the water which the city has been bringing in by rail.

Industrial Applications

Boiler feedwater for high pressure central station steam plants is usually provided either by evaporation or by ion exchange demineralizers regenerated with strong chemicals such as caustic and sulfuric acid. The latter process is increasing greatly in use in new plants since it does not use steam, furnishes the highest purity water, and can be operated when the steam plant is not operating. However, many conventional ion exchange demineralizers become expensive both in first cost and operating cost when total dissolved solids in the feedwater are much over 300 mg/L. The new electric membrane method appears to be economical for handling waters of 500 mg/L solids or more as a pretreatment for conventional ion exchange dimineralizers. The first such installation is now in operation in the Texas Electric Service Company's Permian Basin plant at Monahans, Texas, where an Ionics demineralizer is reducing water of 600 mg/L to approximately 300 mg/L. This is followed by an ion exchange dimineralizer for the removal of the rest of the solids.

FIG. 2. CATHODE SHEET is vital nickel alloy part. Complete stack also contains 300 special plastic membranes. This 1200 gal/hr. unit occupies 3 sq ft of floor area.

Operating Principles

The principle of electric membrane demineralization is quite different from distillation which removes water from brine. It utilizes the movement of salt by an electric current through special membranes. The salt moves out of one stream which is being desalted, and into a second stream which becomes a brine and is discarded.

Most common minerals, when dissolved in water, exist as *ions* which are submicroscopic charged particles free to move through the water under an applied voltage. When two metal plates are put into a container of salt water, and connected to a source of direct current, the current will pass through the water, carried by the movement of positively charged ions (cations) toward the negative plate (cathode) and by the movement of negatively charged ions (anions) toward the positive plate (anode).

With the help of specially developed plastic sheets or membranes, this movement under an applied voltage can be utilized to desalt the water. One type of membrane permits positive ions to pass but bars negative ions. The other type allows negative ions to pass but bars the positive ions. When a number of these membranes are placed in the container as separators, arranged alternately, and a direct current voltage applied, alternate compartments are demineralized.

When suitable gaskets and manifolds are added to the membranes, water to be treated can be piped into half of the compartments while demineralized water is piped out of alternate compartments as a continuous stream.

The equipment has a stacked arrangement of gaskets and membranes with an electrode at each end. Internal manifolds lead water to and from the compartments, and to the end plates for external connections to pumps.

Efficiencies

Typical stacks, such as shown in the accompanying pictures, each have a capacity for 40 to 50 per cent demineralization of 20 gpm of water to the diluting cells.

In C-type units, higher demineralizations are obtained by passing the effluent to additional stacks, and in B-type units by recirculating it through the same stack until the desired purity is obtained.

The plants illustrated operate on a continuous basis with little attention. Chief operating costs are for electric power and for replacement of ion-exchange membranes.

The power consumption of the C-type electric membrane plants, for waters up to 10,000 mg/l, is approximately 7 kwhr per 1,000 gal per 1,000 mg/l removed. This includes current for pumping as well as for the rectifiers for ion transfer. See Table 1 for electrical consumption data on B-type units.

The standard unit operates on 3-phase AC power and is furnished with a rectifier or other converter to supply the direct current.

FIG. 3. TRAILER-MOUNTED Ionics plant with self contained diesel generator.

Membrane replacement costs range from 1,200 to 1,500 dollars per stack per year for small plants, with substantially lower unit costs for large plants.

Materials in Construction

Hastelloy* alloy C high-strength, corrosion-resistant nickel-base alloy is used for the cathode sheet in all electric membrane demineralizer stacks. This metal alloy was selected, it can better withstand the corrosive action of acids and salts contained in brackish and sea water.

In addition to the Hastelloy alloy C cathode sheets, other nickel alloys are used in Ionics equipment whenever particularly corrosive waters are encountered. At installations such as the "Texas Tower" off-shore radar platform, where drinking water is made directly from the salt water, and in the portable unit used in arid areas of the Southwest, the batch tanks are made entirely of corrosion-resisting Monel** nickel-copper alloy.

All tubing in these installations, except the parts near the stack which must be made of an insulating material, is fabricated of 70-30 cupronickel.

Existing Installations

During the past several years, the Ionics equipment has been installed or tested for many different applications in all parts of the world. About 30 plants are now in operation in small municipalities, ice plants, military posts, bottled water plants, isolated oil and running exploration camps, hospitals, utilities and soft drink bottling plants.

Prior to this year, these demineralizers received their widest use in the North African and Middle Eastern area where ten installations are now in operation and six more are scheduled for start-up this year.

The largest of these has been in operation since August, 1957 at the Bahrain Petroleum Company plant on Bahrain Island in the Persian Gulf. A perpetual drought exists in the area, which is one of the hottest and driest regions on earth. The plant has a capacity of 86,400 gpd supplying all the fresh water requirements for a community of 5,000 population. Connected load is 50 kw. The equipment has 15 basic membrane stack units connected in three parallel banks of five series units. Forty per cent of salt entering each unit is removed. Dissolved solids are reduced from 3,100 to 450 mg/L as water passes through each five unit series. Electric power consumption is 15 kwhr per 1,000 gal.

*Registered Trademark of the Union Carbide Corporation

**Registered Trademark of The International Nickel Company, Inc.

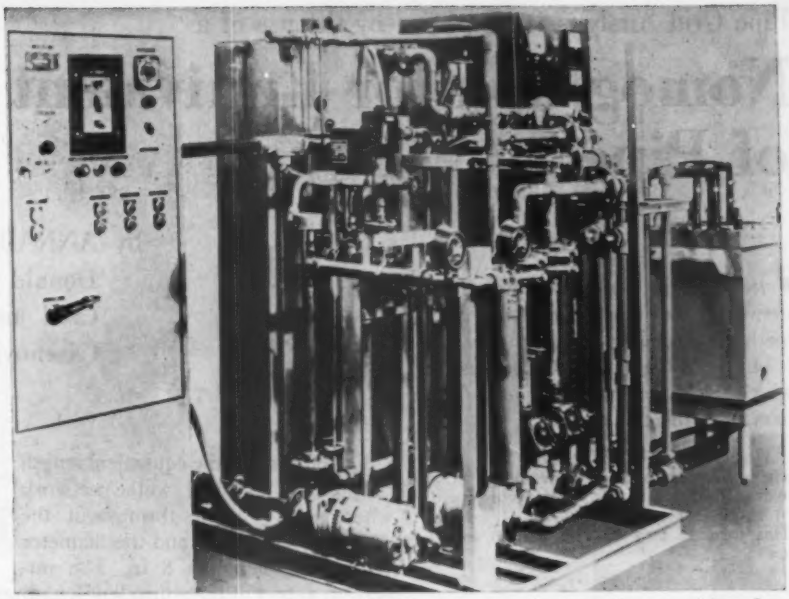


FIG. 4. MODEL 300B membrane demineralizer, smallest made, capable of producing 500 gpd from sea water or 7,000 gpd from brackish water containing 3,000 mg/L dissolved solids.

Particulars: ship wt. 3,000 lb; ship cubage crated 200 cu ft, ht. 6 ft, floor space 11 x 4.5 ft.

The first commercial installation in the United States has been in operation at the Havre, Montana, Air Force Station for over two years, furnishing drinking and cooking water for a 200-man radar station.

The equipment shown in the photograph at the beginning of this article is installed at Texas Electric Service Company's Permian Basin steam-electric plant at Monahans, Texas. It reduces dissolved solids in 1,000 mg/L water to 300 mg/L for boiler feed. This equipment was first installed at the company's Wichita Falls plant in September, 1954, where it operated at an experimental rate of 57,600 gpd (intake).

Recently, another unit has been installed to furnish water for a restaurant on the New York State Thruway between Syracuse and Rochester.

Another unit under construction will supply the entire 40,000 gpd water supply for a 200-man radar station operated by the Air Force at Gettysburg, South Dakota.

The described method of demineralization shows promise wherever there is a problem of demineralizing waters containing from 1,000 to 10,000 mg/L total dissolved solids. It has especial application where there is a choice between a local mineralized supply and a more remote fresh water supply. It is frequently more economical to install such equipment than to haul water by truck or barge, or to build pipelines more than a mile or two in length.

Comparative economics depend on the chemical analysis of the water to be treated, the distance to the nearest fresh water source, local conditions of climate and topography, power rates and chemical costs.

Table I

Production Rates and Energy Consumption for Model 300-B

Feedwater Salinity (mg/L)	Approximate Production rate (gal/day)	Approximate Energy Consumption (kwhr/1,000 gal)
900	28,000	3
1,500	14,000	7
2,000	10,000	10
3,000	7,000	15
4,000	5,500	20
5,000	4,500	25
6,000	4,000	30
8,000	3,000	40
10,000	2,500	50
15,000	1,800	80
20,000	1,400	100
35,000	900	180

Pipe Grid Analysis is simplified by the use of a

Nomograph for Equivalent Lengths of Pipe

by ANNABEL TONG, Structural Engineer
Donald E. Stearns P.E.
Civil and Sanitary Engineers
Cazenovia, N.Y.

■ IN THE analysis of water main network, the most commonly used method for determining the flow distribution is the Hardy Cross method which is based on the Hazen-Williams formula:

$$V = C\,R^{0.63}S^{0.54}0.001^{-0.04}$$

where V = velocity of flow in fps, R = hydraulic radius in f, S = slope of pipe, C = coefficient of friction.
This formula may also be written as follows:

$$h' = \frac{Q^{1.85}\,L}{17076\,C^{1.85}D^{4.86}} \qquad (1)$$

where L = actual length of pipe in ft, h = friction head in ft = S•L, D = diameter of pipe in ft = 4R, Q = flow in gpm

Equivalent Length

To simplify equation [1], one may introduce an equivalent length which is defined by

$$EL = L\,(\frac{100}{C})^{1.85}\,(\frac{.67}{D})^{4.86} \qquad (2)$$

Substituting equation [2] into equation [1], the friction head becomes

$$h = \frac{EL \times Q^{1.85}}{119 \times 10^5} \qquad (3)$$

EL represents the equivalent length of pipe in an ideal water network where the C value throughout the entire system is 100 and the diameter of every pipeline is 8 in. The important aspect of the equivalent length is that it expresses the combined effect of length L, diameter D and the C value of the pipe. Any combination of L, D and C which produces a given equivalent length, will have the same hydraulic effect on the network in question as any other combination of L, D and C values which produces the same value of equivalent length.

Network Analysis

To analyze a water network system by Hardy Cross method, one assumes a trial value of the flow Q in each line then uses the equivalent length instead of the actual length of the pipelines to calculate the head loss h of each line with equation [3] rather than [1]. Corrections are then applied to the assumed Q and the process is repeated until the hydraulic pressure in every loop of the system is balanced. In comparing equation [3] with equation [1] it is seen than a large portion of the tedious computations is eliminated especially since a procedure of cut and trial is employed in this case.

The nomograph shown in Fig 2 will solve equation [2] for pipeline lengths ranging from 50 ft to 10,000 ft. The scale for equivalent length or true length L on this chart can be read to an accuracy within 5 percent except for the higher values near the end of the scale. For practical purposes this degree of accuracy is sufficient to be in line with the accuracy required for general water network analysis. Fig 1 illustrates a water network consisting of four loops and twelve pipe lines, having values of diameter D, length L and friction coefficient C as indicated in the sequence D-L-C alongside each line. From the nomograph the equivalent length of line (1) is determined by running a straight line A across L = 1450 ft and D = 8 in. which intersects the pivot axis at 0. Another line B is then drawn from 0 to C = 120 intersecting the equivalent length scale at 1030 ft. The equivalent lengths for other lines shown in Fig 1 are determined by the same procedure. In case line A intersects the pivot axis beyond the limit of the chart, the actual length of this line may be divided into several sections so that the problem can be worked

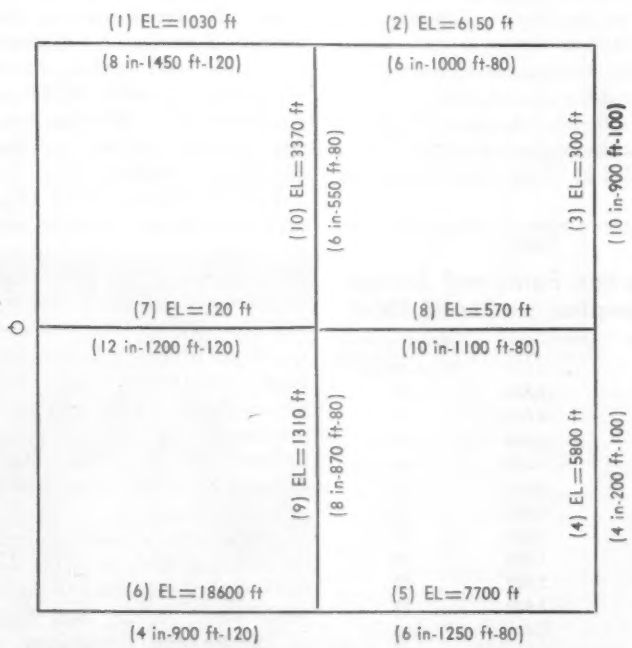


FIG. 1. ILLUSTRATIVE pipe grid with possible values for D, L. and C.

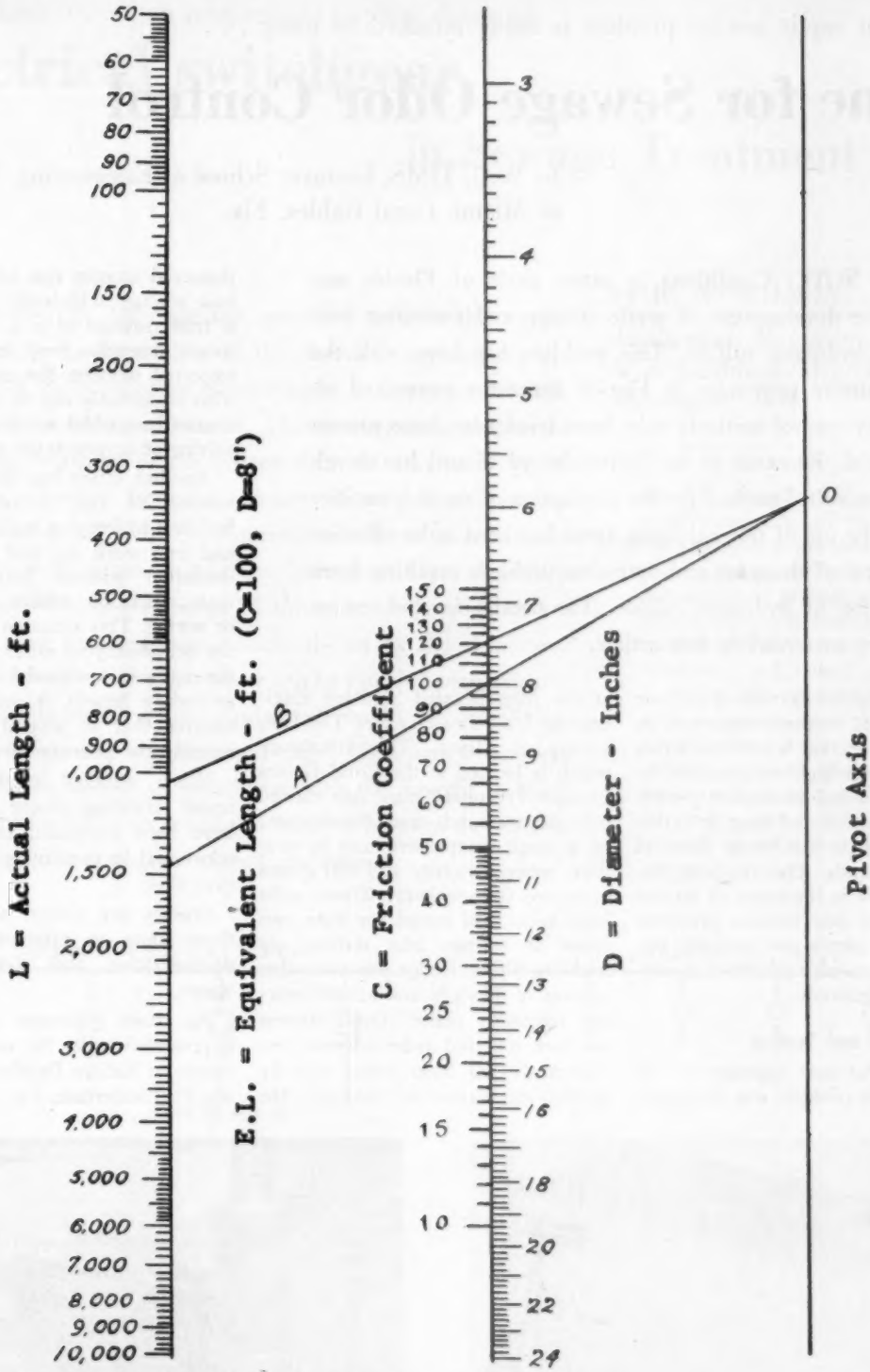


FIG. 2. NOMOGRAPH for Equivalent lengths of pipe.

out in the central region of the chart. For example, line (6) in Fig 1 has L = 900 ft and D = 4 in. Using Fig 2, one finds the equivalent length for 4 in.-300 ft-120 is 6200 ft. The equivalent length for the full length of line (6) is therefore 6200x3 = 18,600 ft.

References

1. A Rapid Method of Analyzing Flow in Water Distribution System Based On The Theory Developed By Professor Hardy Cross, T. F. O'Connor, 1943 *Proceedings, Maryland-Delaware Water and Sewage Association.*

A different septic sewage problem is being attacked by using . . .

Ozone for Sewage Odor Control

by W.C. TIMS, Lecturer School of Engineering, University of Miami, Coral Gables, Fla.

EDITOR'S NOTE: Conditions in many parts of Florida are ideal for the development of septic sewage and concurent production of hydrogen sulfide. This problem has been with the sewage treatment profession in Florida for many years and although many control methods have been tried none have proven too successful. Research at the University of Miami has developed an economical method for the production of small quantities of ozone. The use of this oxidizing agent has been quite effective in the control of the odor and corrosion problem resulting from the generation of hydrogen sulfide. The details for the testing program are presented in this article.

■ HIGH CONCENTRATION of organic and inorganic sulfur compounds in some of the ground water in Florida coupled with a high temperature induced year round incubation period, flat sewer grades and long detention periods result in the break down of these compounds. The resulting hydrogen sulfide is the cause of serious corrosion and deterioration problems at treatment plants and pumping stations as well as odor problems of considerable magnatude.

Development and Testing

A somewhat new approach to the control of this problem was developed at the John Mantell Sanitary Engineering Laboratory of The University of Miami. This laboratory which is located at the Coral Gables Sewage Treatment plant has carried out the reasearch and development on a small inexpensive unit to produce between twenty and 150 grams of ozone O_3 per hour. These units have been field tested for over two years at sewage lifts stations, in trickling filters, sludge pits and other sources of odors in and around sewage treatment plants. Good success has been reported under adverse conditions. It has been found that by careful installation of the unit the dissolved oxygen can be replaced in raw sewage sufficiently to maintain a fresh sewage over a considerably longer detention time than could be expected without the use of ozone. This is probably due to the combination of batericidal action and the dissolving of oxygen in the sewage.

Another effect has been the prevention of rust formation within building by keeping walls, machinery and iron work dry and free of condensation without harmful effects from oxidation within switch gear or wiring. This situation results from the dehumidifying effect of operating the units in a closed building. This secondary benefit is sufficiently attractive that in several cases it is actually the primary benefit desired.

When installed in the air duct under trickling filters these units have been successful in controlling odors and in preventing or reducing filter flies.

Studies are under way utilizing these units to produce ozone for decolorization and sterilization of water.

An ozone generator of this type is produced under the name Oxiconverter by Kellum Brothers Engineering, Ft. Lauderdale, Fla.

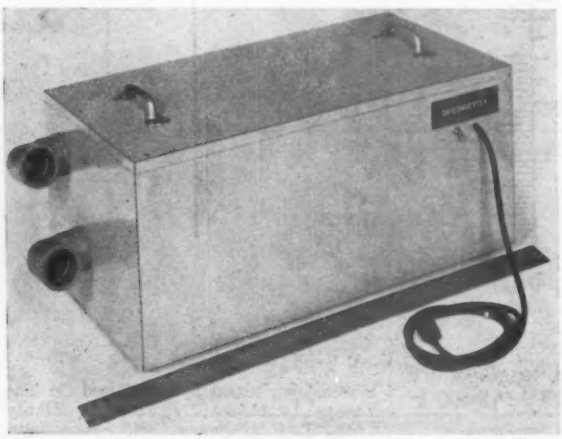


FIG 1 THE OXICONVERTER UNIT

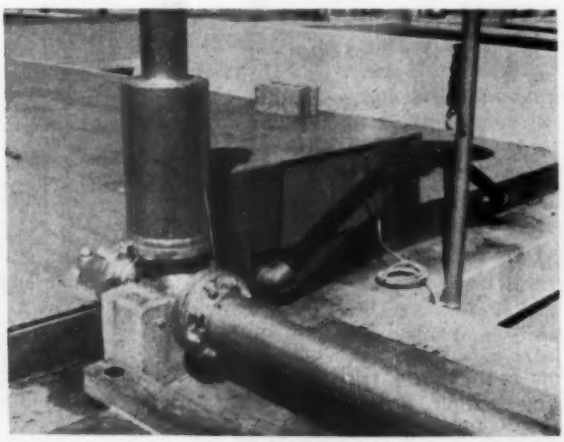


FIG 2 THE UNIT at the grit chamber at the North Miami, Fla. sewage treatment plant.

The fundamentals of an item critical to plant operation

Electrical switchgear in Sewage Treatment plants

by R. N. WILSON,
Application Engineer Switchgear,
Allis Chalmers Mfg. Co.,
Milwaukee, Wis.

EDITOR'S NOTE: Although the specific details of this equipment are more in the domain of the electrical engineer an appreciation of the capabilities of switchgear is important to those in the field of sewage treatment. The continuous operation of most sewage treatment plants is dependent not only on a continual supply of power from the primary source but also on the successful operation of the transformers, switchgear and distribution system of the plant. In addition, how much basic flexibility and dependability in the design of this part of the plant is required to meet the minimum standards set by the regulatory agency and how great an expenditure can be justified economically to improve this aspect of the equipment should be decided by the plant design and operating personnel. This article presents some basic information on switchgear with the thought in mind that it might lead to more fruitful discussion between the electric specialist and his sewage treatment counterpart.

■ THE GROWING TREND toward increased use of the load-center principle in the electrical distribution systems of sewage treatment plants should prompt an examination of the four most common basic load-center circuit arrangements, their economy, and reliability factors.

While the application of switchgear to sewage plant power distribution systems involves many factors which cannot be adequately covered in a single article, a general survey of modern practices in such systems should be helpful to the plant engineer.

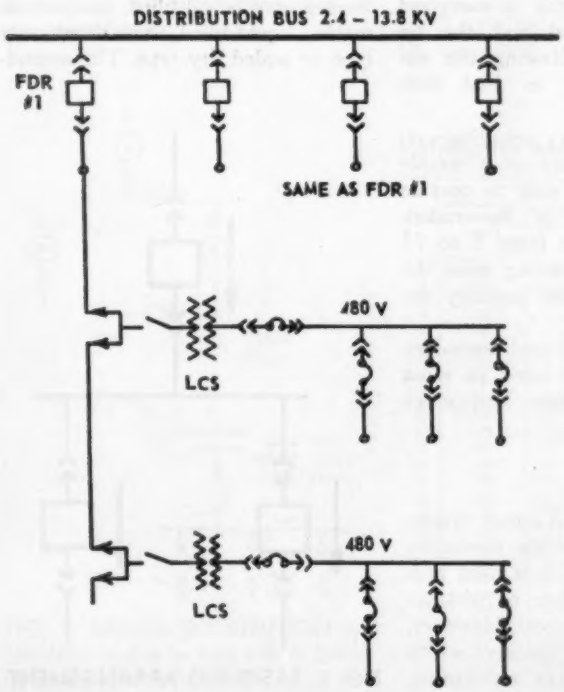


FIG. 1. A MODERN RADIAL distribution system

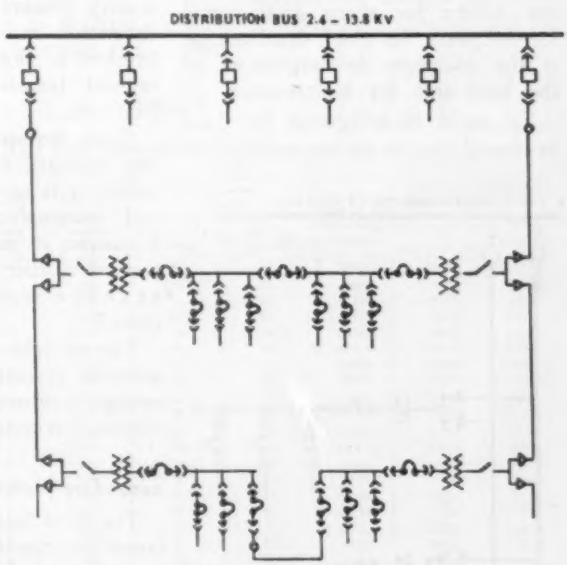


FIG. 2. THE SECONDARY selective system

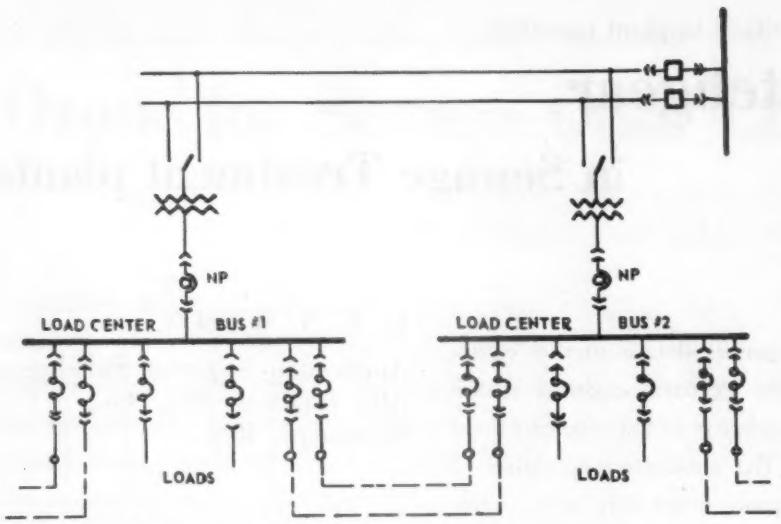


FIG. 3. SECONDARY NETWORK SCHEME

Simple Radial System

The most common arrangement is the simple radial system (Fig 1) which has only one primary feeder and one transformer through which a given secondary bus is supplies. With adequate equipment properly installed, this system is safe, economical, easy to operate and flexible.

While the primary cable and non-inflammable liquid-filled transformer in the simple radial system have a high degree of reliability, approximately one failure per mile per hundred years for the former and one failure for every 2500 transformer years, its chief disadvantage is the complete de-energization of the load area for maintenance.

To avoid de-energizing the load area during scheduled shutdowns and to obtain greater flexibility, the simple radial system can be modified with a normal open tie breaker between pairs of double-ended substations to form a secondary selective arrangement (Fig 2).

Secondary Selective System

During normal operation, each substation of this type system services its own load area independently as in a straight radial system. In case of an outrage of one primary feeder or transformer, the transformer secondary breaker of the de-energized substation is opened and the tie breaker is closed allowing the energized transformer to feed both load areas.

Since the secondary selective system operates normally as a simple radial, it is as safe, easy to operate and uncomplicated as the radial. However, it may be from 5 to 75 percent costlier, depending upon the reserve transformer capacity required.

The straight radial and secondary selective systems are used in most sewage treatment plant load-center distribution systems.

Secondary Network

The third basic load-center system circuit arrangement is the secondary network (Fig 3) which is used in a relatively small number of installations due to its higher cost. However, it does have certain advantages which could justify the larger investment. This system differs from all others in that all substation transformers are operated in parallel and, in the event of a primary feeder or transformer fault, automatically switches off the faulty circuit. This system has the main advantage of allowing large load shifts between substations without appreciably increasing the load on any one transformer.

Primary Selective System

The primary selective system, Fig 4, the fourth basic arrangement, differs from the other three in that two primary feeders are brought to each substation. This system provides service to the load-center substations in event of a primary cable failure. Its use may be desirable where load centers are widely dispersed and primary cables are located in areas where they are subject to damage.

Substations

Basic component of the load-center system with secondary voltages 600 and below is the load center unit substation. A load center substation consists of incoming line, transformer and secondary distribution feeder sections.

The incoming line section may be metal-clad drawout switchgear, a fused or unfused magnetizing current or load break switch, an oil cutout or a junction box. The transformer may be oil-filled, non-inflammable liquid-filled, ventilated dry type or sealed dry type. The second-

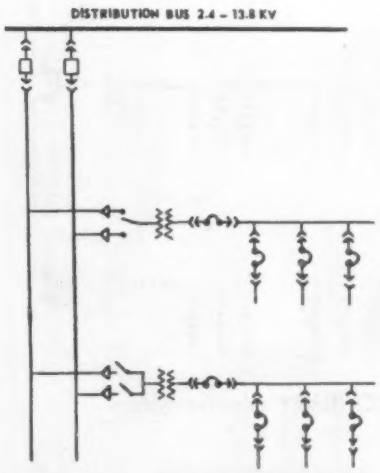


FIG. 4. PRIMARY SELECTIVE SYSTEM

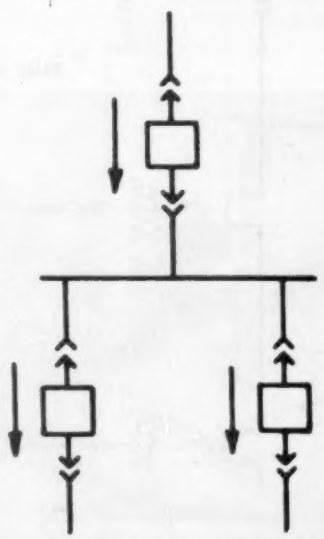


FIG. 5. BASIC BUS ARRANGEMENT

ary distribution section is normally metal-enclosed drawout switchgear with a large air circuit breakers.

Selection of load-center switchgear must be coordinated with the primary feeder system and the secondary feeder circuits to insure use of breakers with adequate interrupting and continuous current ratings. After the correct beakers are chosen, the number of feeder breakers are selected on the basis of load rquirements.

Transformer secondary or main breakers are often used for feeder back-up protection, for quick de-energization of all feeders in case of emergency, and for future expansion to transform a radial to a secondary selective system. In some cases, large air circuit breakers are used for motor starting if the starting duty is not repetitive.

Regardless of the load-center circuit arrangement, metal-clad drawout switchgear provides the vital link between the power source and the load-centers. In every primary circuit arrangement it provides short-circuit and overload protection to the primary feeder cables and the load-center transformers.

The basic bus arrangement consists of one source breaker and two or more feeder breakers Fig 5. Any other arrangement is used mainly to improve service reliability to all or part of the load during scheduled outages or in the event of source or equipment failure.

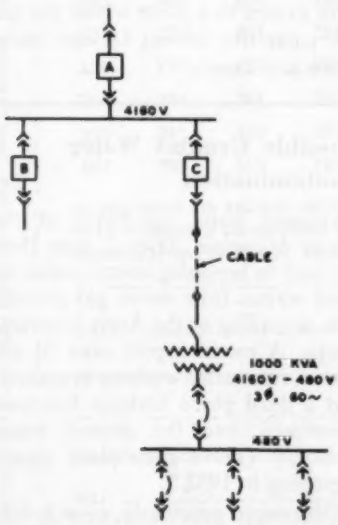


FIG. 7. RADIAL DISTRIBUTION system from source to load side of feeder in load center substation

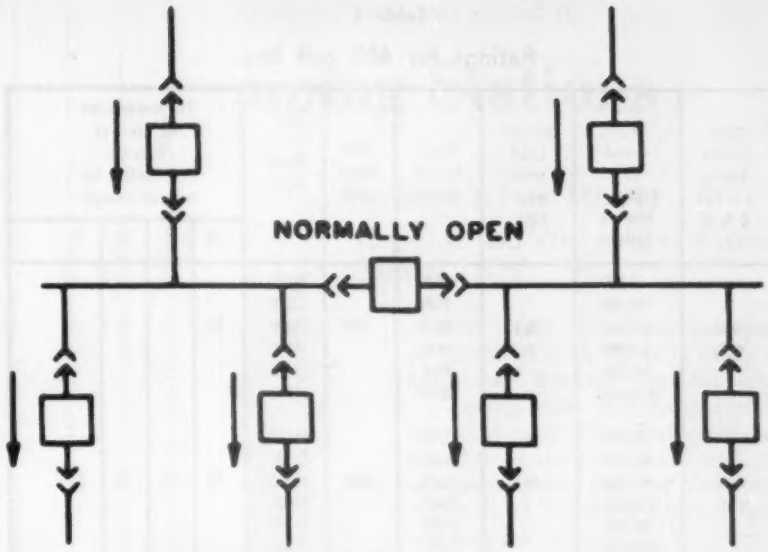


FIG. 6. TWO SOURCE SECTIONAL BUS

A common variation of the basic primary bus arrangement is the two source sectionalized-bus Fig 6. Here the bus tie is operated normally open and each source breaker supplies one half of the bus. If one source fails or is shut down for maintenance, the source breaker is opened, the tie breaker closed allowing the other source to supply all of the bus. This arrangement is similar to the secondary selective system and is simple, safe and easy to operate.

Short Circuit Protection

An example of how to determine the magnitude of short-circuits is to be found in the single line diagram of a radial distribution system from the source to the load side of a feeder in the load-center unit sub-station Fig 7.

In this instance, the power company calculated the available short-circuit at the point of entrance to the plant as 100,000 kva. This figure was arrived at by calculating the fault currents available from all of the power company's rotating machines, generators and synchronous condensers, and reducing this current in proportion to the amount of impedance between the generators and the plant.

Table I

Ratings for Metal Clad Equipment with oilless power circuit breakers

Item	Interrupting Rating in Mva	Rating in Kv	Minimum Operating KV at Rated Mva	Continuous Current Rating in Amperes At 60 Cycles	Withstand Test KV		Momentary Rating in RMS Total Amperes	Interrupting Ratings in RMS Total Amperes For 60-cycle Systems	
					At 60 Cycles (RMS)	Impulse (Crest Value)		At Rated Voltage	Maximum
1	75	4.16	3.5	1200	19	60	20000	10400	12500
2	150	4.16	3.5	600	19	60	40000	21000	25000
3	150	4.16	3.5	1200	19	60	40000	21000	25000
4	150	4.16	3.5	2000	19	60	40000	21000	25000
5	250	4.16	3.85	1200	19	60	60000	35000	37500
6	250	4.16	3.85	2000	19	60	60000	35000	37500
7	350	4.16	4	1200	19	60	80000	48600	50000
8	350	4.16	4	3000	19	60	80000	48600	50000
9	250	7.2	4.6	1200	36	95	51000	20000	32000
10	250	7.2	4.6	2000	36	95	51000	20000	32000
11	500	7.2	6.6	1200	36	95	70000	40000	44000
12	500	7.2	6.6	2000	36	95	70000	40000	44000
13	150	13.8	6.6	600	36	95	20000	6300	13000
14	150	13.8	6.6	1200	36	95	20000	6300	13000
15	250	13.8	6.6	1200	36	95	35000	10600	22000
16	250	13.8	6.6	2000	36	95	35000	10600	22000
17	500	13.8	11.5	1200	36	95	40000	21000	25000
18	500	13.8	11.5	2000	36	95	40000	21000	25000
19	500	13.8	11.5	1200	36	95	60000	21000	25000
20	500	13.8	11.5	2000	36	95	60000	21000	25000
21	750	13.8	11.5	1200	36	95	60000	31500	37500
22	750	13.8	11.5	2000	36	95	60000	31500	37500
23	750	13.8	11.5	1200	36	95	80000	31500	37500
24	750	13.8	11.5	2000	36	95	80000	31500	37500
25	1500	13.8	11.5	1200 3000	36	95	80000	42000	50000

Table 2

Ratings for 480 volt bus

Transformer Rating 3 o KVA & % IZ	Max. Short Circuit KVA Available Primary System	Normal Load Continuous Amp.	Transformer Alone	100% Motor Load	Combined	Recommendated AC Breaker Type LA (See Table 1 for trip coil ratings)			
						M	F	C	S
	50,000		8900		10700				
	100,000		9400		11200				
300	150,000	361	9600	1800	11400	25	15	15	15
4 5%	250,000		9800		11600				
	500,000		9900		11700				
	Unlimited		10000		11800				
	50,000		13700		16700				
	100,000		15100		18100				
500	150,000	601	15600	3000	18600	50	15	15	25
4 5%	250,000		16000		19000				
	500,000		16400		19400				
	Unlimited		16800		19800				
	50,000		15500		20000				
	100,000		17300		21800				
750	150,000	902	18100	4500	22600	50	15	15	25
5.75%	250,000		18700		23200				
	500,000		19200		23700				
	Unlimited		19600		24100				
	50,000		19500		25500				
	100,000		22400		28400				
1000	150,000	1203	23500	6000	29500	50	25	15	50
5.75%	250,000		24500		30500				
	500,000		25300		31300				
	Unlimited		26200		32200				
	50,000		25800		34800		25		
	100,000		31200		40200		50		
1500	150,000	1804	33500	9000	42500	75	50	15	50
5.75%	250,000		35600		44600		50		
	500,000		37300		46300		50		
	Unlimited		39400		48400		50		
	50,000		30900		42900		50	15	50
	100,000		38200		50200		50	25	75
2000	150,000	2406	42600	12000	54600	75	50	25	75
5.75%	250,000		45900		57900		50	25	75
	500,000		48700		60700		75	25	75
	Unlimited		52400		64400		75	25	75

With the interrupting capacity of breakers, A, B and C determined, the proper breaker rating, 4160 volts with a 150,000 kva, interrupting capacity is selected from Table 1. This breaker will give some reserve capacity in the event the utility's available short-circuit should increase with the addition of a new generator or if large synchronous motors are added to the plant's distribution system.

To determine available short-circuit on the 480-volt bus, neglect the impedance of the primary cable. By omitting the cable impedance, the available short-circuit at the primary of the 1000-kva transformer is 100, 000 kva.

According to Table 2, the short-circuit on the 480-volt bus is 22,400 amperes if no motors are connected to the bus. Motors contribute short-circuit current for a brief period. If it is assumed that there is a 1000-kva motor load connected to the 480-volt bus, the actual short-circuit current available is 28,400 amperes. Therefore, the secondary breakers should have a minimum short circuit capacity of 28,400 amperes at 480 volts.

It is never wise to select the rating of a circuit breaker without knowing all the facts concerning future expansion of the sewage plant and future plans of the utility. Often industrial plant distribution systems have grown to a point where the circuit protective devices become inadequate and unsafe.

Taste and Odor in Public Water Supplies

will be investigated during a twelve-month research program conducted by the Franklin Institute, Philadelphia, Pa., under the sponsorship of the Manufacturing Chemists' Association.

The program is part of a project by the MCA's Water Pollution Abatement Committee to discover and compile useful information which may be used by the public, industry and governmental regulatory agencies in the control of water pollution. Robert A. Baker, senior staff engineer at the Franklin Institute, will direct the program.

An Association spokesman stated, that it is hoped the program will contribute toward the "ultimate development of an acceptable yardstick for the measurement of taste and odor pollution of public water."

Another research program on water pollution abatement, sponsored by the MCA, has been in operation for the past five years at the Academy of Natural Sciences of Philadelphia. Studies in this program have shown how a river recovers from the effects of pollution with the progressive return of bacteria, algae, fish, invertebrates, and other forms of life natural to a healthy stream.

Possible Ground Water Contamination

Ground water northwest of the Rocky Mountain Arsenal, near Denver may be becoming contaminated by plant wastes from nerve gas production, according to the Army Chemical Corps. A recent report says "it appears a reasonable working hypothesis that a third phyto toxicant has been introduced into the ground water from GB (nerve gas) plant wastes beginning in 1953."

Discovered previously were 2, 4-D and certain chlorates. GB nerve gas production at Rocky Mountain Arsenal is now on a standby basis.

The problem of flooding of an industrial park at Hartford, Conn. was solved by

Two Storm Water Pumping Stations

by ROBERT DYMENT,
Magazine and Newspaper Writer,
Dunkirk, N.Y.

RESUME: The elevation of the North and South Meadow sections of Hartford, Conn. is below the level of the Connecticut River at most river stages. Since the entire city is separated by a system of dykes from the river all of the storm water collects in this area from which it must be pumped over the dykes to the river. As the existing pumping station did not have capacity to cope with the larger storms plans to convert the Meadow into an industrial park required the construction of new pumping stations. These new stations are equipped with ten diesel driven pumps with a capacity of 375,000 gpm which is in excess of the runoff from a ten year storm. These stations are the largest of their type in the east and are designed to operate if necessary without outside power and with a minimum of manpower.

■ IT WASN'T so much the river as the land that was causing trouble in North and South Meadows, the lowest sections of land around Hartford, Connecticut.

Five miles of dikes restrained the Connecticut River. They offered protection against a river depth up to 45 feet. But this didn't keep the Meadows dry. Excess water falling within the Hartford area drained into these two areas. And the existing pumping stations which had a total capacity of only 108,000 gallons per minute couldn't handle all the water. Capacity to move a minimum of 216,000 gpm. was needed.

The situation was serious not only because it involved lives and property, but because Hartford wanted to develop North and South Meadows as Industrial Park Zones in order to bring new industry into the area.

Flooding today is a serious problem with many cities and communities throughout the nation and no city knows better than the New England City of Hartford, Conn. It suffered untold losses in the 1955 hurricanes which ripped through their city and surrounding areas.

More Capacity Needed

The city administration determined to see that such a disaster doesn't happen again, at least as far as flooding is concerned took steps to protect the area by installing an entirely new storm water pumping system, which included the installation of diesel engines in one of the largest installations of its type in the eastern United States.

By installing 10 Caterpillar D397 diesels to drive the existing pumps at higher speeds, Hartford was able to boost pumping capacity to 375,000 gpm, which gives them a comfortable safety factor. The diesels were installed in the modern South Station

FIG. 1. AN EXTERIOR VIEW of one of the two pumping stations at Hartford, Conn.

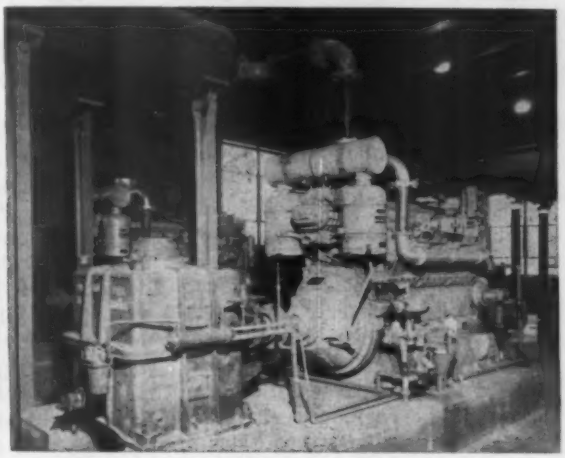


FIG. 2. GENERAL VIEW of some of the V-12 Diesel Engines and gear heads located in the North and South pumping stations.

FIG. 3. THE DIESEL POWERED GENERATOR, shown center, powers the air compressors for starting the diesel prime movers at the city of Hartford's south pumping station. This electric set also furnished power to operate the flood control gates in event of a public power failure.

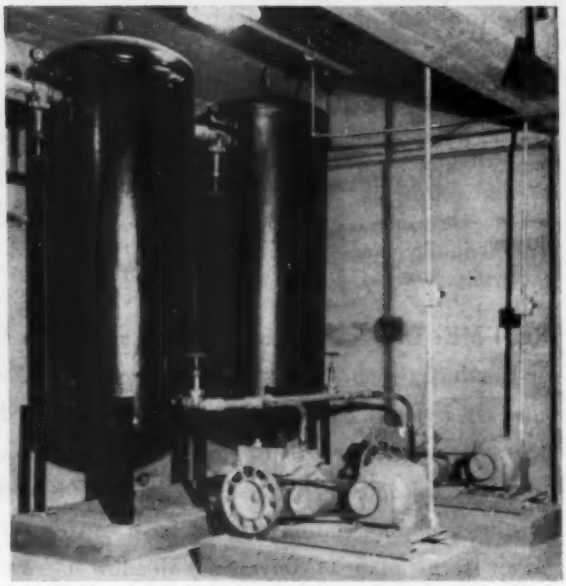


FIG. 4. TWO ELECTRIC POWERED air compressors and storage tanks supply compressed air for starting motors on the V-12 diesel engines at the city of Hartford's pumping station.

and North Station at Hartford.

As mentioned, five miles of dikes protect the City from the Connecticut River during flood stage. Two storm water pumping stations lift the water from back of the dike into the river. The dike gives protection to a river height of 45 ft. South Meadows Pumping Station, because of the lowness of the land, has to start pumping when the river reaches elevation 8 ft. The storage pond elevation is kept down to about elevation 5 ft. North and South Meadows are the lower sections of the Hartford area. Storm water runoff and drainage within the Hartford area runs to this sections and must be pumped out.

North and South Meadows are two miles apart. Previous to the installation of the ten diesels, the pumps were operated by electricity and gasoline engines.

The reasons for the change was twofold: More capacity was needed at higher river levels after experiencing the 1955 hurricane, the gas engines were becoming obsolete and parts were hard to obtain. The City changed to diesels, upped the horsepower on the engines to drive the impellers of existing pumps faster in order to obtain more capacity at higher river heads.

Another important reason for the change was the development of North and South Meadows. These two areas were made industrial Park Zones designed to attract industries to Hartford. As a result of the improvement to the pumping stations, they now get rid of water much faster and stay ahead of water coming in. If this pumping arrangement had existed in 1955, the flooding would not have occurred.

The pumping capacity is based on the intensity of a 10-year rainfall as determined from a curve developed from a 35 year record.

South Pumping Station

Four 38,000 gpm and two 37,000 gpm pumps give this station a capacity of 226,000 gpm at the required 30 ft head. These pumps as well as those at the North Pumping station are driven by Caterpillar D397 diesels with Rotts type blowers through Philadelphia Gear Works reduction gears. The station is equipped with a Cat D318 generating set. This unit is to provide emergency power for the starting air compressors and for operating the flood gates. At the south station eight gates are already installed and two more are to be added. Operation of the station during the period that it will be needed most will probably call for the use of this emergency equipment. A 20,000 gal fuel storage system is also provided at this installation.

North Pumping Station

This unit contains four pumps with a combined capacity of 151,000 gpm which is provided by three 38,000 gpm pumps and one 37,000 gpm capacity unit. Facilities for the storage of 10,000 gals of fuel is provided and a gasoline driven standby generator will provide emergency power.

Each engine in both pumping stations is equipped with heat exchange fresh water cooling regulated to conserve city water. Twin disc clutchs were installed. In the event of high cooling water temperature, low oil pressure or overspeed an audio visual alarm system provides a warning before the safety system automatically takes the engine out of service. Starting air is supplied by dual compressors with a 32 cu ft receiver. The exhaust noise level is controlled by silences. Three pumps are DeLaval 36 in. 35,000 gpm pumps and seven are x 36 in. Morris Machine units of the same output.

Metcalf and Eddy were consulting engineers on the project which will protect Hartford from storm water problems for many years.

THE R. D. WOOD HYDRANT

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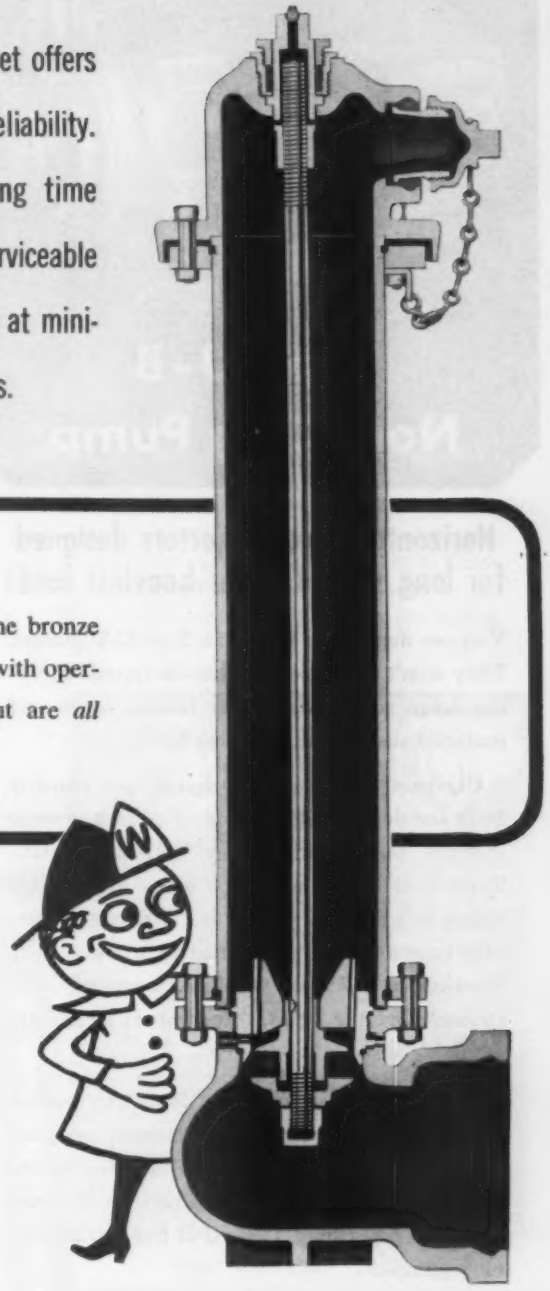

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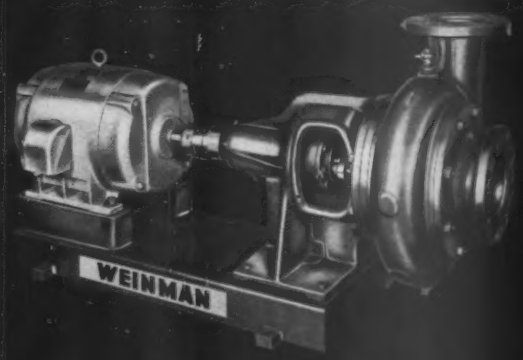

Type U-B Non-Clog Pump

Horizontal sewage ejectors designed for long service under heaviest loads

You can depend on Weinman Type U-B pumps. They won't clog . . . easily handle liquids carrying large solids, stringy or fibrous trash and material suspended in sludge form.

Compact and simple in design, yet sturdily built for dependable service, Weinman sewage ejectors out-perform other horizontal units. Type U-B non-clog pumps are equipped for either belt drive or motor drive. Enclosed non-clog type impeller is designed to produce steep head-capacity curve. Cast iron regularly furnished, bronze or stainless steel impellers available also.

For full information about Weinman sewage ejectors or other centrifugal pumps, see your Weinman pump specialist. He is listed in the Yellow Pages. Or, write us direct for Bulletin No. 1500 describing Type U-B horizontal non-clog pumps.

Centrifugal Specialists

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JUNE						
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Feb. 14-18—New York, N. Y. (*Hotel Statler*) AMERICAN INSTITUTE OF MINING, METALLURGICAL & PETROLEUM ENGINEERS.

Feb. 21-24—Atlanta, Ga. (*Biltmore Hotel*) AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.

Mar. 14-18—Dallas, Texas (*Memorial Auditorium*) Annual Convention NATIONAL ASSOCIATION OF CORROSION ENGINEERS.

Mar. 16-18—Chicago, Ill. (*Pick-Congress Hotel*) ILLINOIS SECTION, A.W.W.A. Secy: D. W. Johnson, Research Engr. Cast Iron Pipe Research Assn., 3440 Prudential Plaza, Chicago 1.

Mar. 16-18—Baton Rouge, La. (*La. State University*) Short Course for Superintendents and Operators of Water and Sewerage Systems. Fred H. Fenn, Dean, College of Engineering.

Mar. 17—Boston, Mass. (*Statler Hotel*) NEW ENGLAND SECTION, A.W.W.A. Secy: R. M. Soule Assoc. Sanit. Engr. State Dept. of Public Health, 511 State House, Boston.

Mar. 20-23— Savannah, Ga. (*DeSoto Hotel*) SOUTHEASTERN SECTION, A.W.W.A. Secy: N. M. de Jarnette, Engr. Water Quality Div., State Dept. of Public Health, 309 State Office Bldg., Atlanta.

Mar. 23-24—Huntington, W. Va. (*Hotel Pritchard*) WEST VIRGINIA SEWAGE AND INDUSTRIAL WASTES ASSN., Secy-Treas: Glen O. Fortney, St. Dept. of Health, Charleston 5, W. Va.

Mar. 24-25—Huntington, W. Va. (*Hotel Pritchard*) WEST VIRGINIA SECTION A.W.W.A. Secy: H. W. Hetzer, Engr., Union Carbide Chem. Co., Box 8361 South Charleston.

Mar. 29—Atlantic City, N. J. (*Hotel Traymore*) JOINT GASEOUS-LIQUID INDUSTRIAL WASTES CONFER. Eastern Air Pollution Control Assn. Secy: A. T. Leahey, P. O. Box 32, W. Trenton, N. J.

Mar. 30, April 1—Atlantic City, N. J. (*Hotel Traymore*) NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSN. Secy: A. T. Leahey, P. O. Box 32, W. Trenton, N. J.

Apr. 3-8— New York City, N. Y. (*Coliseum*) 6TH NUCLEAR CONGRESS sponsored by EJC and other engineering and scientific societies including A.W.W.A.

Apr. 5-7—Binghamton, N. Y. (*Sheraton-Binghamton Hotel*) NEW YORK SECTION, A.W.W.A., Secy: Kimball Blanchard, N. Y. Branch Sales Off., Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 5-14—Cleveland, O. (*Hotel Netherland-Hilton*) NATIONAL MEETING—AMER. CHEM. SOCIETY DIV. OF WATER & SAN. CHEMISTRY Symposium on Indust. Wastes in conjunctn. with 137th Meeting., Prof. C. Fred Gurnham Head of Dept. of Chem. Engrg., Michigan State Univ., E. Lansing.

Apr. 7-8—Raleigh, N. C. (*State College Campus*) 9TH ANNUAL MUNICIPAL & INDUST. WASTE CONFER. Write: The Div. of College Extn., P. O. Box 5125 State College Sta., Raleigh, N. C.

Apr. 20-22—New York, N. Y. (*Manhattan College*) THIRD BIOLOGICAL WASTE TREATMENT CONFER. Write: W. Wesley Eckenfelder, Assoc. Prof. Manhattan College, New York 71.

Apr. 20-22—Lincoln, Neb. (*Cornhusker Hotel*) NEBRASKA SECTION, A.W.W.A., Secy: J. J. Rossbach Jr., Civ. Engr. Metropolitan Utilities Dist. 3906 N. 48th St., Omaha.

Apr. 20-22—Emporia, Kan. (*Broadview Hotel*) KANSAS SECTION, A.W.W.A., Secy: H. W. Badley, Repr., Neptune Meter Co. 119 W. Cloud, Salina.

Apr. 22—Monterey Cal. (*Mark Thomas Inn*) CALIFORNIA SECTION, A.W.W.A., Secy: R. E. Dodson, Jr., Supt. of Water Dept. of Utilities, Balboa Pk., San Diego.

Apr. 22-24—Emporia, Kan. (*Broadview Hotel*) KANSAS SEWAGE AND INDUSTRIAL WASTES, ASSN. Secy-Treas: James F. Aiken, 1900 E. 9th St. Wichita

Apr. 24-27—Buffalo, N. Y. (*Statler Hotel*) CANADIAN SECTION A.W.W.A., Secy: A. E. Berry, 72, Grenville St., Toronto, Ont.

Apr. 27-30—Berkeley, Calif. (*Claremont Hotel*) Calif. SEWAGE AND INDUSTRIAL WASTES ASSN. Write A. D. Leipzig, Secy.-Treas., c/o Hyperion Sewage Treatment Plant, 1200 Vista Del Mar, Venice, Calif.

Apr. 28-30—Tucson, Arizona (*Pioneer Hotel*) ARIZONA SECTION, A.W.W.A., Secy: A. D. Cox Jr. Secy. & Comptroller, Arizona Water Co., Box 5347, Phoenix

Apr. 28-30—Billings, Mont. (*Northern Hotel*) MONTANA SECTION, A.W.W.A., Secy: A. W. Clarkson, Asst. Dir., Div. of Envirn. Sanit. State Board of Health, Helena.

Apr. 28-30—Billings Mont. (*Northern Hotel*) MONTANA SEWAGE & INDUST. WASTES ASSN. Secy-Treas: A. W. Clarkson, Div. of Envirn. Sanit., State Brd. of Health, Helena

May 4-6—Portland, Ore. (*Benson Hotel*) PACIFIC NORTHWEST SECTION, A.W.W.A., Secy: F. D. Jones, W. 2108 Maxwell Ave., Spokane 11, Wash.

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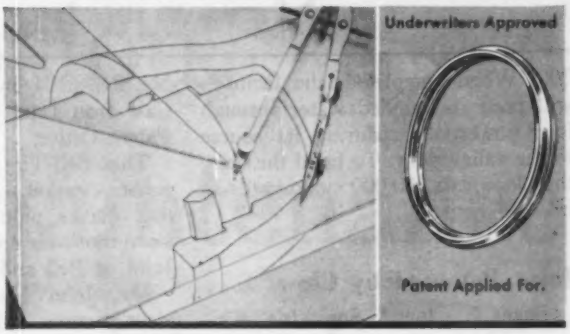

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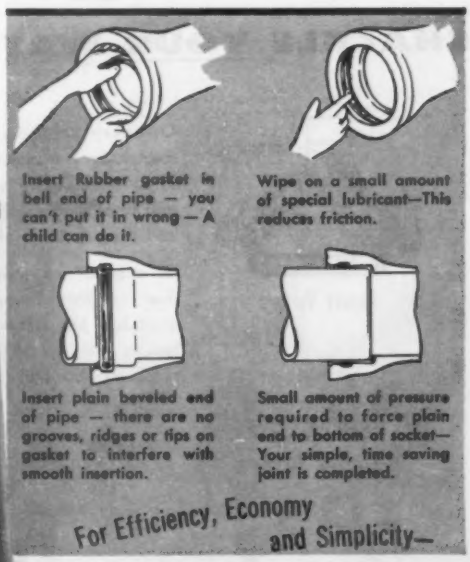
Insert Rubber gasket in bell end of pipe — you can't put it in wrong — A child can do it.
Wipe on a small amount of special lubricant—This reduces friction.
Insert plain beveled end of pipe — there are no grooves, ridges or tips on gasket to interfere with smooth insertion.
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News of Suppliers

CONTINUED FROM PAGE 36A

000. When completed, the facilities will pour impounded water through four powerhouses during its course to the valley floor. To build the dam, the placement 700,000 cubic yards of fill was nedeed.

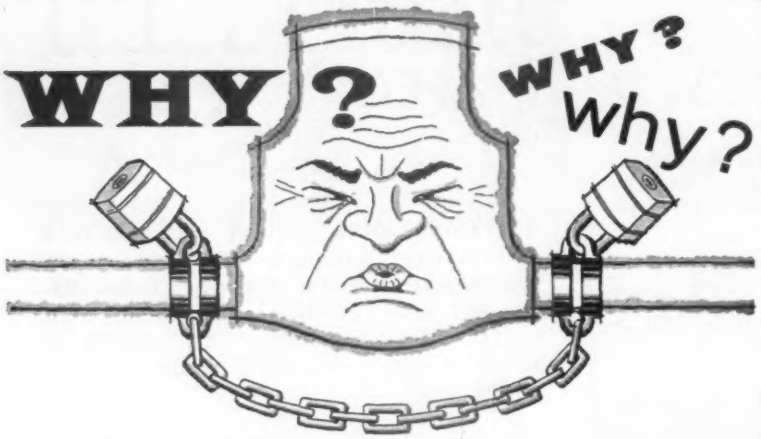
Joint Patented by Clow

James B. Clow & Sons, Inc., Chicago, Ill., has been granted Patent No. 2,898,131 on the Clow Bell-Tite Cast Iron Pipe Joint, by the U. S. Patent Office.

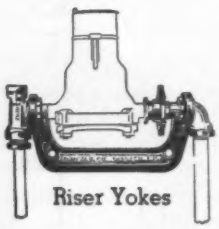
The Bell-Tite Joint is a single rubber gasket, slip-on type joint that makes pipe laying faster and more economical than the Mechanical Joint or Bell and Spigot Joint.

Mr. John Madden, Clow President, states that approximately 70% of all Clow cast iron pipe production is Bell-Tite Joint pipe.

Clow licensees also making Bell-Tite Joint pipe are the Lynchburg Foundry Company, Lynchburg, Virginia, the Lone Star Steel Company, Dallas, Texas, and the Anthes-Imperial Company, Ltd, of Canada.



SHACKLE YOUR WATER METERS?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Angle Yokes

Straight Line Yokes

Ordinary old-fashioned meter couplings are frequently like shackles on your water meters. They often make meter changing so difficult and troublesome that periodic testing is omitted and proper meter maintenance neglected.

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EASILY

There are models for every condition. Send for free catalog.

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FOR BETTER WATER SERVICES
THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Eimco Makes Two Top Appointments

Eimco Corporation, Salt Lake City, Utah, has announced two, major managerial appointments: Wayne L. Dowdey, formerly manager of Eimco's Southern District, is now General Sales Manager for the corporation; and Paul O. Richter, an Eimco vice-president, has been named General Manager of the Filter Division.

Mr. Dowdey, in his new post as general sales manager, will be responsible for all domestic sales of the corporation's various divisions. He joined Eimco in 1945 as a sales engineer and advanced to the position of manager of the Southern and Pittsburgh districts, prior to his present appointment. A member of the A.I.M.E. since 1945, he is presently Chairman of the Mineral Benefication Division of that organization.

Mr. Richter has been connected with Eimco for twenty-four years. He is a graduate of Northwestern University and, in addition to his former duties, will now be active in engineering and production management for the Filter Division. Mr. Richter will base his activities at the corporation's head offices in Salt Lake City.

Robinson Clay Initiates Expansion Program

Robinson Clay Product Co., Akron, Ohio, has initiated a $2,000,000 expansion program designed to increase production capacity at its Factory 10 at Mogadore, Ohio, and its Factory 8 at Pottstown, Pa.

One of the features of these plans is a 540-foot by 200-foot addition to the Mogadore plant. This structure, which will be constructed by fabricating aluminum siding over steel girders, will provide the company with more than 100,000 additional-square feet of manufacturing space at their Factory 10.

The plans for the Mogadore plant

CONTINUED ON PAGE 104A

"No corrosion, negligible maintenance and continued high carrying capacity with Transite Pipe."

—F. A. Anderson and C. L. Johnson, Johnson & Anderson, Inc., Pontiac, Mich.

"First cost and economical operation make Johns-Manville's Transite Pipe a practical long-term investment," say Messrs. Johnson and Anderson, consulting engineers, pictured at right. "Despite this economy its performance is superior in many ways. There's no corrosion, negligible maintenance and continued high carrying capacity . . . helping through the years to save in the operation of the system. These many economies make it easier for communities to build and expand their water systems."

Transite's maintained carrying capacity keeps pumping costs low. Its strength, durability and corrosion-resistance cut maintenance—provide years of trouble-free service. Further savings are effected by the sure coupling method that assures a tight seal at every joint. Add to this Transite's natural interior smoothness and you see why it helps reduce community water system costs. Let us send you "Facts and Data for Engineers" book. Write Johns-Manville, Box 14 (WS-2), New York 16, N. Y.

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INCREASES filter output with better quality effluent.
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IDEAL for industrial acid and alkaline solutions.
EFFECTIVE filtration from entire bed.
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FOR OVER 60 YEARS!
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MANUFACTURING CO.
DEPENDABLE MODERN
WATER PURIFICATION EQUIPMENT
CALL OR WRITE
MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

News of Supplies

CONTINUED FROM PAGE 102A

also include the addition of two auger presses, dryers, a pre-heater and a tunnel kiln. The new tunnel kiln will be the largest in the industry and will be able to accommodate a kiln car 10½ feet by 10½ feet. Clay pipe 5 feet long may be fired in the kiln.

The construction of six, new 40-foot periodic kilns highlights the expansion of the Pottstown plant. Completion of the kilns, and other plant changes, will increase production capacity by one-third. The overall program entails the improvements and expansion of processing, drying and firing facilities.

Griffin Pipe Appoints Colton

Griffin Pipe Division, Griffin Wheel Company, Chicago, Ill., has announced the appointment of William R. Colton as District Manager, St. Paul sales. Mr. Colton will serve Minnesota, Northern Wisconsin and Upper Michigan.

Before joining the newly created Griffin Pipe Division, he was associated with the Warren Foundry and Pipe Division in Boston, Mass.

F & P Offers Calibration Service on West Coast

Fischer & Porter Co., Hatboro, Pa., has announced that their Los Angeles branch now offers complete calibration facilities for all major types of flow measuring devices. Any type of flowmeter (variable-area, variable head, turbine, obstructionless, positive displacement) can be calibrated. Tests simulating customer's operating conditions are accurate to ½ of 1 percent.

The Liquid Calibration Unit can rapidly calibrate within a flow range from 0.3 to 110 gallons per minute with viscosities from 1.1 to 36 centistokes. The Gas Calibration Unit, just recently installed, handled flow rates from 100 scc/min to 5 scfm with pressures from atmospheric to 240 psia.

90% cut in operating and maintenance cost means

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New, transistorized
M-SCOPE PIPE FINDER
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Rugged, transistorized construction practically eliminates maintenance costs . . . extends battery life to a year or more. Pinpoint accuracy, greatest depth penetration make the M-Scope first choice in the field!
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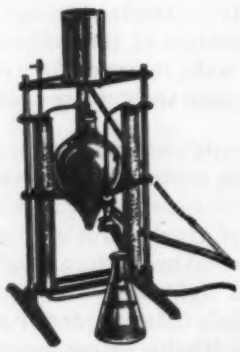
For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895
WRITE:
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P. O. Box 2V Richmond 5, Va.

New Bulletins

AVAILABLE FREE

Submersible Pumps

213

Tait Manufacturing Co., Dayton, Ohio, has published a condensed catalog explaining the features of its 6" Dolphin submersible pump line. The booklet presents information covering three series: high head, mid-range, and high capacity.

As pointed out in the catalog, the pumps are suitable for many municipal and institutional applications. They are designed for wells 0 to 800 feet in depth and can deliver from 30 to 140 gpm. Available sizes are 5, 7½, 10 and 15 hp; all motors are 100% designed, manufactured and warranted by Tait.

Automatic Batch Formulator

214

Richardson Scale Company, Clifton, N. J., is offering a new, product data sheet that describes its Formula Capsule designed to eliminate manual errors in blending, proportioning and batching operations. This miniature control makes the correct proportioning of blending materials an automatic operation, and also enables the formula to be duplicated, batch after batch, automatically.

The new, data sheet explains the operating procedure by which the pocketsize unit programs the weighing of ingredients. Quantities from 1 to 24 solid and/or liquid ingredients may be programmed.

Additional information included in the data sheet are the steps to be followed in setting up a formula, and how the control is used with the company's Select-O-Weigh system.

Plastic Pipe and Fittings

215

Kraloy Plastic Pipe Co., Inc., Los Angeles, Calif., has just published a new, 36-page handbook which contains pertinent and detailed information on the use of Kraloy PVC plastic pipe, fittings and valves.

Designed especially for engineers, the booklet includes specification, construction and installation data. A comprehensive corrosion resistance chart, covering seven types of plastic pipe used for carrying 162 chemicals, is one of the features of the book.

Other charts show the maximum operating pressures for PVC pipe at various temperatures, the friction loss characteristics of water flow through PVC pipe, and the flow of natural gas indicating pressure drop in pounds per square inch per 1000 feet of PVC pipe.

Valves and Lubricating Devices

216

Lunkenheimer Co., Cincinnati, Ohio, has recently released a newly revised edition of its comprehensive 500-page valve catalog, "'60", which features a special 24-page Valve Selector section and more than 100 pages of valuable engineering data.

In addition, the complete line of steel, iron, bronze, and PVC valves is presented, as well as the specifications of lubricating devices, boiler mountings, cocks and other products. The main new items covered by the new catalog are the complete specifications of the LQ600 Bronze Globe valves, the Luncor PVC valves, and the Forged Steel Gate valves.

CONTINUED ON PAGE 106A

the bigger your pumping problems . . . the better your reasons for giving them to

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If you're puzzled over which pumps to use for water works, municipal or industrial power plant service, drainage, irrigation or flood control, see C. H. Wheeler. Your representative can help you even if you need capacities exceeding 220,000 gpm and heads of 75 feet. He'll give you expert advice on pump design and construction, and station arrangement suggestions you'll find helpful.

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Prepared in your plant with N sodium silicate and a reacting chemical. No charge for license under our N-Sol Process Patents.

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New Bulletins

CONTINUED FROM PAGE 105A

The illustrated and thumb-indexed Valve Selector Guide, which groups valves according to pressure classifications, is designed to enable the reader to find specifications, reference data, and code requirements for any Lunkenheimer valve in a few seconds.

Valves for Filtration Plants

217

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has recently issued an 8-page bulletin describing their line of filter drain valves, backwash valves, and rewash valves, specifically designed for filtration plant service.

The bulletin is fully illustrated showing in detail the main features of the valves and how they might be arranged in a typical installation. Other features include dimensional tables, a layout diagram, and job specifications information.

Also included in the bulletin is advice on how to reduce installation costs, particularly by using space saving techniques.

Hydrologic Instruments

218

Leupold and Stevens Instruments, Inc., Portland, Ore., have published a complete "short form" catalog of their hydrologic instruments and accessories. Prepared as a guide for engineers and others interested in hydrologic instruments, the new catalog lists the available instruments, and presents photographs of each piece of hydrologic equipment manufactured by the firm, and a brief summary of the equipment's use.

Among the items described in the catalog are, Stevens liquid flow recorders and indicators, liquid level recorders, telemetering systems, servo controls for recorders and transmitters, precipator records and gauges, and various accessory equipment.

This equipment is used for measuring liquid levels, and for collecting data for flood control and irrigation projects, water systems, and sewerage disposal systems.

Integrated Electric Control

219

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., recently made available literature describing their new, Electrik Tel-O-Set system which is an integrated system for electric process control. The literature is comprised of individual bulletins that explain and illustrate the operations of the various components making up the Tel-O-Set system.

The bulletins cover the two transducers, the two transmitters, the recorders and indicators, the control stations, and the power supply. The system features two-wire, D.C. transmission and requires no line power at the field-mounted transmitters and transducers.

"Canned" Pumps

220

Chempump Division, Fostoria Corporation, Huntington Valley, Pa., is offering a new, 4-page bulletin which presents, with description, photographs and charts, their line of seal-less pumps designed for leak-proof pumping.

The design and operation of the pumps are explained in the bulletin, and data for the proper selection of a unit for specific needs are included. These pumps do not use either stuffing box packing or mechanical seals. Instead, the pump and motor are incorporated into a single, leak-proof unit, and is further designed to require no lubrication.

Pneumatic Metering Pump

221

Associated Control Equipment, Inc., Coraopolis, Pa., has published a 4-page bulletin that describes the operating principles of its Servo-Gauge metering pump and its controller.

Also included in this bulletin are discussions of five, typical applications which are explained in terms of suggestions for similar uses. The design data listed include maximum capacity, operating characteristics, stroking rate, materials of construction and actuating power requirements.

Diagrams accompany the discussions of the unit and its applications.

Rigs for Water Wells

222

Ingersoll-Rand Co., Phillipsburg, N. J., has issued a new, 12-page bulletin describing its Drillmaster, mobile, well-drilling rig which was designed to utilize the company's Downhole drill.

On-the-job photographs, job costs charts, and detailed specification data provide a clear presentation of the unit and its operation. Another feature of the bulletin is a description of the Downhole drill and a cut-away showing its main components.

Dimensional data of the Drillmaster are included in the bulletin, and an illustrated list of the unit's accessories is also provided.

Water Softening Manual

223

Cochrane Corp., Philadelphia, Pa., has announced publication of a booklet that describes the sodium zeolite process of water softening and provides information for the selecting and sizing of processing equipment.

Among the topics discussed are: the suitability of automatic or manual controls; calculating softening capacity; and the more frequently used zeolite materials, both siliceous and non-siliceous.

Illustrations and cut-away drawings are included that show typical treatment systems. The use of a new hydromatic, single control valve to operate zeolite softening units is also explained. Use of this new equipment makes possible semi or fully automatic operation.

High Capacity Flow Indicator

224

Brooks Rotameter Co., Lansdale, Pa., has made available a Design Specification Sheet which provides the essential details of its new, high capacity flow meter featuring an integral by-pass design.

Among the items presented are, materials of construction, capacities, scale and rating.

Indicating Equipment

225

Leeds and Northrup Company, Philadelphia, Pa., is offering a 2-page data sheet which describes its Speedomax H indicators, recorders and controllers for pH and redox.

Bearing Blocks and Takeups

226

Link-Belt Company, Chicago, Ill., has published a 16-page book which contains detailed information on the company's complete line of babbitted, bronze and plain bore bearing blocks and takeups.

Continuous Belt Drum Filter

227

Eimco Corporation, Salt Lake City, Utah, has released a new, 12-page bulletin intended to show how five-way savings can be made in the continuous vacuum filtration of difficult slurries with the use of their Eimcobelt continuous belt drum filter.

Small Sewage Treatment Plant Discussed

228

Dorr-Oliver, Inc., Stamford, Conn., announces the availability of a new, 8-page bulletin entitled, "Small Plant Sewage Treatment". This bulletin describes the design, operation and advantages of four different equipment units each of which provides both clarification and sludge digestion in a single tank, and which are particularly applicable to small scale operations.

Heavy Duty Sludge Pumps

229

Mechanical Equipment Division, Komline-Sanderson Engineering Corp., Peapack, N. J., has recently published a 6-page brochure which describes their dual valve, plunger, heavy duty sludge pumps.

Valve Line Described

230

Circle Seal Products Co., Inc., Pasadena, Calif., has made available a 4-page booklet which describes their line of valves, including check valves, relief valves, shutoff valves, plug valves and custom valves.

Pneumatic Level Transmitters

231

Bailey Meter Company, Cleveland, Ohio, is offering its new, 4-page bulletin describing their pneumatic, force-balance transmitters designed for the measurement of level over range spans of 1 inch water to 2000 inches of water, at maximum service pressures of 50, 1500 and 5000 psig.

DARLEY MAGNETIC DIPPING NEEDLE $17.50

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REPRESENTATIVES WANTED—Sales representatives wanted in Chicago, Detroit and Metropolitan New York and New Jersey, to exploit PAYNE DEAN operators as shown on page 11A.

Electronic Computing System

232

Royal McBee Corporation, Data Processing Division, Port Chester, N. Y., has published the complete specifications of its new RPC-4000 electronic computing system in a recently released catalog sheet.

The literature provides details of the unit which is a fully transistorized, electronic, stored program, general purpose computing system, designed for both engineering and business data processing. The basic system consists of the computer and a punched paper tape, typewriter input-output unit all of which are described and illustrated in the release.

Oscillator is Pneumatically Actuated

233

Associated Control Equipment, Coraopolis, Pa., has announced the availability of a new bulletin that describes their Servo-Gauge oscillator. This product is a pneumatically actuated timer adjustable from 0.3 to 60 complete cycles a minute.

The bulletin explains the principle of operation, includes design data, and describes typical applications of the unit. A diagram and cutaway drawing illustrate the operation and construction features.

New Demineralizer Bulletin

234

Cochrane Corporation, Philadelphia, Pa., has available a 4-page bulletin covering its line of standardized "Uni-Pac", packaged mixed bed demineralizers, designed especially for process water applications. The size of this new "M" Series ranges to 13,200 gallons per hour.

The publication contains useful information on the use of the demineralizing process which eliminates variables in water, and on their effects on product quality control. Further information is presented through diagrams, and specification tables.

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WANTED—Utility District Engineer. South Tahoe Public Utility District, Bijou, California, is accepting applications for position of District Engineer. Applicant must have degree in Civil Engineering from a registered college and must be a registered civil engineer in the state of California or eligible for licensing. Applicant must have experience in sewerage systems and sewage treatment. Duties will include supervision of the maintenance, operation, and construction of water and sewerage systems, including a new 2.5 MGD activated sludge sewage treatment plant. Excellent opportunity in a rapidly expanding area. Submit complete resume of experience, etc., to South Tahoe Public Utility District, Bijou, California.

WANTED WATER SUPERINTENDENT Applications being accepted until February 15 for water superintendent to manage complete water works system. Includes 3 MGPD lime-soda ash treatment plant. Salary $6000. per annum. Age range 30-50. Send applications to I. L. Samuelson, City Engineer, Storm Lake, Iowa.

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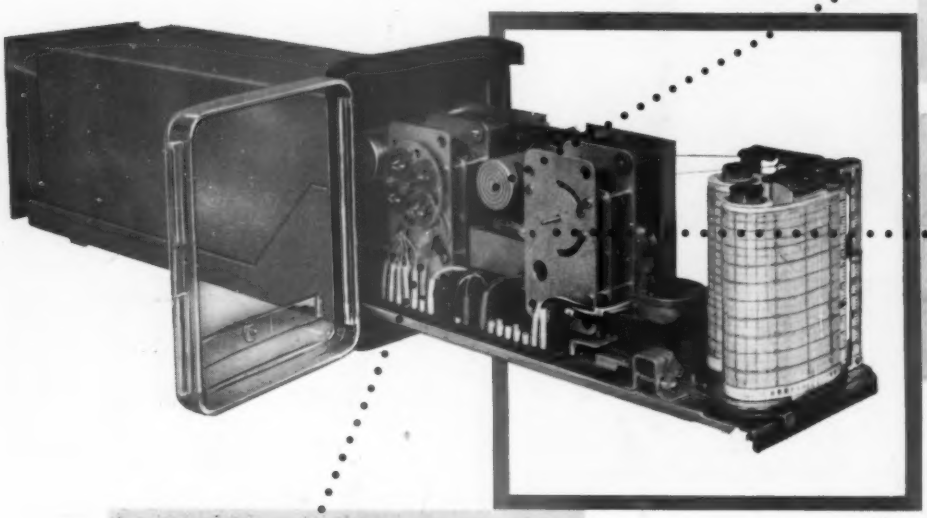

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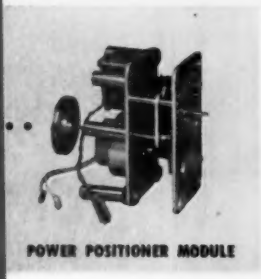

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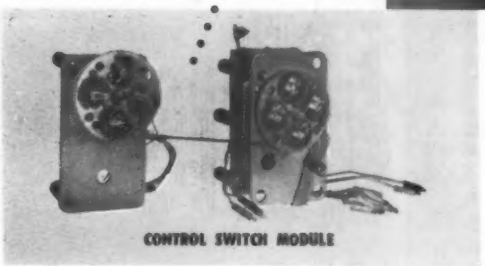

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